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5,662,731

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L4: Entry 47 of 54 File: USPT Dec 10, 1996

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TITLE: Methods for the manufacture of sheets having a highly inorganically filled organic polymer matrix

DATE-ISSUED: December 10, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
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CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. A method for manufacturing a sheet having an inorganically filled matrix, the method comprising the steps of:
(a) mixing together water, a water-dispersible organic polymer binder, an inert inorganic aggregate, and a fibrous material in order to form an inorganically filled mixture in which the organic polymer binder is substantially solvated in the water, the organic polymer binder and fibrous material together having a concentration in a range from about 5% to about 60% by volume of total solids in the mixture;
(b) passing the inorganically filled mixture between forming rollers to form a sheet having a desired thickness; and
(c) evaporating a substantial portion of the water from the sheet to harden the organic polymer binder in less than about 10 minutes after forming the sheet, thereby binding the aggregates and fibers in the sheet, wherein the sheet has a thickness of about 1 cm or less.
2. A method for manufacturing a sheet as defined in claim 1, wherein the sheet has a thickness up to about 3 mm.
3. A method for manufacturing a sheet as defined in claim 1, wherein the sheet has a thickness up to about 1 mm.
4. A method for manufacturing a sheet as defined in claim 1, wherein the sheet has a thickness in a range from about 0.01 mm to about 0.5 mm.
5. A method for manufacturing a sheet as defined in claim 1, wherein the evaporation of a substantial portion of the water from the sheet increases the cohesive strength of the inorganically filled matrix.
6. A method for manufacturing a sheet as defined in claim 1, wherein the evaporation of a substantial portion of the water from the sheet increases the form stability of the sheet.
7. A method for manufacturing a sheet as defined in claim 1, wherein the organic polymer binder and fibrous material have a combined concentration of from about 5% to about 40% by volume of total solids in the inorganically filled mixture.
8. A method for manufacturing a sheet as defined in claim 1, wherein the organic polymer binder and fibrous material have a combined concentration of from about 5% to about 30% by volume of total solids in the inorganically filled mixture.
9. A method for manufacturing a sheet having an inorganically filled matrix, the method comprising the steps of:
(a) mixing together water, a water-dispersible organic polymer binder, an aggregate material, and a fibrous material to form an inorganically filled mixture in which the organic polymer binder is substantially solvated in the water, wherein the aggregate material has a concentration in a range from about 40% to about 98% by volume of total solids in the inorganically filled mixture;
(b) passing the inorganically filled mixture between forming rollers to form a coherent sheet having a thickness; and
(c) evaporating a substantial portion of the water from the sheet to harden the organic

polymer binder in less than about 10 minutes after forming the sheet, thereby binding the aggregates to the fibers in the sheet, wherein the sheet has a thickness of about 1 cm or less.

10. A method for manufacturing a sheet as defined in claim 9, wherein step (a) further includes adding a hydraulically settable material to the inorganically filled mixture in an amount great enough to impart a binding effect within the inorganically filled matrix.

11. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled mixture has a rheology such that the sheet made therefrom has sufficient cohesive strength to maintain integrity as a sheet as it is suspended between different sets of rollers.

12. A method for manufacturing a sheet as defined in claim 9, wherein the water has a concentration in a range from about 5% to about 50% by volume of the inorganically filled mixture.

13. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled mixture has a yield stress in a range from about 2 kPa to about 5 MPa.

14. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled mixture has a yield stress in a range from about 100 kPa to about 1 MPa.

15. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled mixture has a yield stress in a range from about 200 kPa to about 700 kPa.

16. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled mixture has a viscosity and wherein step (a) includes mixing a dispersant into the inorganically filled mixture in order to reduce the viscosity of the mixture.

17. A method for manufacturing a sheet as defined in claim 16, wherein the dispersant is selected from the group consisting of sulfonated naphthalene-formaldehyde condensate, sulfonated melamine-formaldehyde condensate, lignosulfonate, acrylic acid, and mixtures or derivatives thereof.

18. A method for manufacturing a sheet as defined in claim 9, wherein step (a) is carried out by means of a high shear mixer.

19. A method for manufacturing a sheet as defined in claim 9, wherein step (a) is carried out by means of a kneader-mixer.

20. A method for manufacturing a sheet as defined in claim 9, wherein the forming rollers are heated.

21. A method for manufacturing a sheet as defined in claim 20, wherein heating the rollers reduces adhesion of the inorganically filled mixture to the rollers.

22. A method for manufacturing a sheet as defined in claim 20, wherein the heated rollers remove at least a portion of the water from the inorganically filled sheet.

23. A method for manufacturing a sheet as defined in claim 20, wherein the heated rollers increase the form stability of the inorganically filled sheet.

24. A method for manufacturing a sheet as defined in claim 20, wherein the rollers are heated to a temperature in a range from about 50.degree. C. to about 120.degree. C.

25. A method for manufacturing a sheet as defined in claim 20, wherein the rollers are heated to a temperature in a range from about 60.degree. C. to about 85.degree. C.

26. A method for manufacturing a sheet as defined in claim 9, wherein the forming rollers are cooled to a temperature and wherein step (b) includes the step of heating the inorganically filled mixture to a temperature that is significantly higher than the temperature of the forming rollers in order to reduce adhesion between the heated mixture and the cooled rollers.

27. A method for manufacturing a sheet as defined in claim 9, wherein the rollers used in step (b) have a coating which reduces sticking between the inorganically filled mixture and the rollers.

28. A method for manufacturing a sheet as defined in claim 9, further including the step of extruding the inorganically filled mixture through a die prior to step (b).

29. A method for manufacturing a sheet as defined in claim 28, wherein the inorganically filled mixture is extruded using an auger extruder.

30. A method for manufacturing a sheet as defined in claim 29, wherein the auger extruder has means for removing unwanted air voids within the inorganically filled mixture.

31. A method for manufacturing a sheet as defined in claim 28, wherein the inorganically filled mixture is extruded using a piston extruder.

32. A method for manufacturing a sheet as defined in claim 28, wherein the inorganically filled mixture is extruded into a sheet having a thickness and then passed between the forming rollers having a nip that is smaller than the thickness of the extruded sheet before it passes between the forming rollers.

33. A method for manufacturing a sheet as defined in claim 32, wherein the thickness of the sheet is reduced in steps by passing the sheet between a plurality of forming rollers having progressively smaller nips.

34. A method for manufacturing a sheet as defined in claim 9, wherein step (b) yields a sheet in which the individual fibers of the fibrous material have a substantially random orientation within the inorganically filled matrix.

35. A method for manufacturing a sheet as defined in claim 9, wherein step (b) yields a sheet in which the individual fibers of the fibrous material have a substantially unidirectional orientation within the inorganically filled matrix.

36. A method for manufacturing a sheet as defined in claim 9, wherein step (b) yields a sheet in which the individual fibers of the fibrous material have a substantially

bidirectional orientation.
37. A method for manufacturing a sheet as defined in claim 9, wherein step (b) yields a sheet in which the individual fibers of the fibrous material at or near a surface of the sheet have a substantially greater directional orientation than the fibers within the interior of the sheet.
38. A method for manufacturing a sheet as defined in claim 9, wherein step (c) is carried out with the aid of a heated drying roller.
39. A method for manufacturing a sheet as defined in claim 9, wherein step (c) is carried out with the aid of a heated chamber.
40. A method for manufacturing a sheet as defined in claim 9, wherein step (c) is carried out with the aid of a means for drying selected from the group consisting of a microwave oven, an infrared oven, a vacuum chamber, and combinations of the foregoing.
41. A method for manufacturing a sheet as defined in claim 9, further including the step of applying a coating material to a surface of the sheet.
42. A method for manufacturing a sheet as defined in claim 41, wherein the coating material comprises a biodegradable material.
43. A method for manufacturing a sheet as defined in claim 41, wherein the coating material increases the ability of the sheet to resist water degradation.
44. A method for manufacturing a sheet as defined in claim 41, wherein the coating material increases flexibility of the sheet.
45. A method for manufacturing a sheet as defined in claim 41, wherein the coating material is selected from the group consisting of melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxy-propylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, edible oils, and mixtures or derivatives thereof.
46. A method for manufacturing a sheet as defined in claim 41, wherein the coating material is selected from the group consisting of sodium silicate, calcium carbonate, kaolin, silicon oxide, aluminum oxide, ceramic, and mixtures or derivatives thereof.
47. A method for manufacturing a sheet as defined in claim 9, further including the step of laminating a second sheet to the sheet.
48. A method for manufacturing a sheet as defined in claim 47, wherein the second sheet has an inorganically filled matrix.
49. A method for manufacturing a sheet as defined in claim 47, wherein the second sheet is selected from the group consisting of organic polymer sheets, metal foils, fiber sheets, ceramic sheets, ionomers, elastomeric sheets, plastic sheets, cellophane sheets, nylon sheets, wax sheets, metallized films, and combinations thereof.
50. A method for manufacturing a sheet as defined in claim 9, further including the step of corrugating the sheet.
51. A method for manufacturing a sheet as defined in claim 9, further including the step of creping the sheet.
52. A method for manufacturing a sheet as defined in claim 9, further including the step of compacting the sheet.
53. A method for manufacturing a sheet as defined in claim 52, further including the step of drying the sheet following the compaction step.
54. A method for manufacturing a sheet as defined in claim 9, further including the step of applying an indicia onto the sheet.
55. A method for manufacturing a sheet as defined in claim 54, wherein the step of applying an indicia comprises passing the sheet between a pair of rollers capable of forming an imprint within the sheet.
56. A method for manufacturing a sheet as defined in claim 9, further including the step of score cutting the sheet.
57. A method for manufacturing a sheet as defined in claim 9, further including the step of scoring the sheet.
58. A method for manufacturing a sheet as defined in claim 9, further including the step of perforating the sheet.
59. A method for manufacturing a sheet as defined in claim 9, further including the step of finishing of the sheet in order to alter the quality of a surface of the sheet.
60. A method for manufacturing a sheet as defined in claim 59, wherein the finishing step is carried out by passing the sheet between a pair of calendering rollers in order to increase the smoothness of a surface of the sheet.
61. A method for manufacturing a sheet as defined in claim 59, wherein the finishing step is carried out by passing the sheet between a pair of rollers which impart a textured surface to the sheet.
62. A method for manufacturing a sheet as defined in claim 9, further including the step of rolling the sheet from which a substantial portion of the water has been evaporated onto a spool in order to form a roll.
63. A method for manufacturing a sheet as defined in claim 9, further including the step of cutting the sheet into discontinuous sheets and stacking said discontinuous sheets in order to form a stack of sheets.
64. A method for manufacturing a sheet as defined in claim 9, further including the step of remoistening a substantially hardened sheet in order to impart flexibility to the sheet.
65. A method for manufacturing a sheet as defined in claim 9, further including the step of incorporating finely dispersed voids within the inorganically filled matrix.

66. A method for manufacturing a sheet as defined in claim 9, further including the step of using the sheet to manufacture printed material.
67. A method for manufacturing a sheet as defined in claim 9, further including the step of fashioning the sheet into a container.
68. A method for manufacturing a sheet as defined in claim 67, wherein the container comprises a food or beverage container.
69. A method for manufacturing a sheet as defined in claim 9, further including the step of fashioning the sheet into an article of manufacture.
70. A method for manufacturing a sheet as defined in claim 9, wherein the thickness of the inorganically filled matrix of the sheet is less than about 3 mm.
71. A method for manufacturing a sheet as defined in claim 9, wherein the thickness of the inorganically filled matrix of the sheet is less than about 1 mm.
72. A method for manufacturing a sheet as defined in claim 9, wherein the thickness of the inorganically filled matrix of the sheet is in a range from about 0.01 mm to about 0.5 min.
73. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled matrix of the sheet is water degradable.
74. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled matrix of the sheet is readily degradable into environmentally neutral components.

75. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled matrix of the sheet has a maximum density of about 1.5 g/cm.sup.3.
76. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled matrix of the sheet can elongate up to about 20% without completely fracturing while in a green state.
77. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled matrix of the sheet can elongate in a range from about 0.5% to about 8% without completely fracturing while in a substantially hardened state.
78. A method for manufacturing a sheet as defined in claim 9, wherein the sheet has a tensile strength in a range from about 5 MPa to about 60 MPa.
79. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled mixture includes inorganic components having a concentration in a range from about 50% to about 95% by volume of total solids in the inorganically filled mixture.
80. A method for manufacturing a sheet as defined in claim 9, wherein the inorganically filled mixture includes inorganic components having a concentration in a range from about 60% to about 80% by volume of total solids in the inorganically filled mixture.
81. A method for manufacturing a sheet as defined in claim 9, wherein the aggregate material comprises at least two different aggregate materials.
82. A method for manufacturing a sheet as defined in claim 9, wherein the aggregate material comprises individual particles that are size optimized in order to achieve a desired particle packing density of the aggregate material within the inorganically filled moldable mixture.
83. A method for manufacturing a sheet as defined in claim 82, wherein the particle packing density of the aggregate material is at least about 0.65.
84. A method for manufacturing a sheet as defined in claim 82, wherein the particle packing density of the aggregate material is at least about 0.85.
85. A method for manufacturing a sheet as defined in claim 9, wherein the aggregate material comprises a light-weight aggregate which reduces the density and increases the insulation ability of the sheet.
86. A method for manufacturing a sheet as defined in claim 85, wherein the lightweight aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.
87. A method for manufacturing a sheet as defined in claim 9, wherein the aggregate material is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
88. A method for manufacturing a sheet as defined in claim 9, wherein the aggregate material includes an inorganic gel.
89. A method for manufacturing a sheet as defined in claim 88, wherein the inorganic gel is selected from the group consisting of silica gel, aluminum silicate gel, calcium silicate gel, and mixtures thereof.
90. A method for manufacturing a sheet as defined in claim 88, wherein the inorganic gel has a concentration such that a desired amount of moisture is maintained within the inorganically filled matrix of the sheet.
91. A method for manufacturing a sheet as defined in claim 9, wherein the aggregate material comprises a polymerized silicate.
92. A method for manufacturing a sheet as defined in claim 9, wherein the aggregate material comprises an organic aggregate selected from the group consisting of seeds, starches, gelatins, agar-type materials, and mixtures or derivatives thereof.
93. A method for manufacturing a sheet as defined in claim 9, wherein the organic polymer binder and fibrous material have a total concentration in a range from about 5% to about 60% by volume of total solids in the inorganically filled mixture.
94. A method for manufacturing a sheet as defined in claim 93, wherein the organic polymer binder and fibrous material have a total concentration less than about 40% by

volume of total solids in the inorganically filled mixture.
95. A method for manufacturing a sheet as defined in claim 93, wherein the organic polymer binder and fibrous material have a total concentration less than about 30% by volume of total solids in the inorganically filled mixture.
96. A method for manufacturing a sheet as defined in claim 9, wherein the water-dispersable organic polymer binder has a concentration in a range from about 1% to about 50% by volume of total solids in the inorganically filled mixture.
97. A method for manufacturing a sheet as defined in claim 9, wherein the water-dispersable organic polymer binder has a concentration in a range from about 2% to about 30% by volume of total solids in the inorganically filled mixture.
98. A method for manufacturing a sheet as defined in claim 9, wherein the water-dispersable organic polymer binder has a concentration in a range from about 5% to about 20% by volume of total solids in the inorganically filled mixture.
99. A method for manufacturing a sheet as defined in claim 9, wherein the water-dispersable organic polymer binder comprises a cellulose-based polymer.
100. A method for manufacturing a sheet as defined in claim 99, wherein the cellulose-based polymer is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
101. A method for manufacturing a sheet as defined in claim 9, wherein the water-dispersable organic polymer binder comprises a starch-based polymer.
102. A method for manufacturing a sheet as defined in claim 101, wherein the starch-based polymer is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
103. A method for manufacturing a sheet as defined in claim 9, wherein the water-dispersable organic polymer binder comprises a protein-based material.
104. A method for manufacturing a sheet as defined in claim 103, wherein the protein-based material is selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
105. A method for manufacturing a sheet as defined in claim 9, wherein the water-dispersable organic polymer binder is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
106. A method for manufacturing a sheet as defined in claim 103, wherein the water-dispersable organic polymer binder comprises a synthetic organic polymer.
107. A method for manufacturing a sheet as defined in claim 106, wherein the synthetic organic polymer is selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
108. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous material has a concentration in a range from about 0.5% to about 50% by volume of total solids in the inorganically filled mixture.
109. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous material has a concentration in a range from about 5% to about 40% by volume of total solids in the inorganically filled mixture.
110. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous material has a concentration in a range from about 15% to about 30% by volume of total solids in the inorganically filled mixture.
111. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous material comprises organic fibers.
112. A method for manufacturing a sheet as defined in claim 111, wherein the organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, and southern hardwood fibers, and mixtures or derivatives thereof.
113. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous material comprises inorganic fibers.
114. A method for manufacturing a sheet as defined in claim 113, wherein the inorganic fibers are selected from the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures or derivatives thereof.
115. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous material comprises a mixture of different fibers having varying strengths and flexibilities.
116. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous material increases the tensile strength of the sheet.
117. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous material increases flexibility of the sheet.
118. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous material includes individual fibers having an average aspect ratio of at least about 10:1.
119. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous

material includes individual fibers having an average aspect ratio of at least about 100:1.
120. A method for manufacturing a sheet as defined in claim 9, wherein the fibrous material includes individual fibers having an average aspect ratio of at least about 1000:1.
121. A method for manufacturing a sheet as defined in claim 9, wherein the aggregate material includes a hydraulically settable material.
122. A method for manufacturing a sheet as defined in claim 121, wherein the hydraulically settable material comprises a hydraulic cement.
123. A method for manufacturing a sheet as defined in claim 122, wherein the hydraulic cement comprises portland grey cement.
124. A method for manufacturing a sheet as defined in claim 122, wherein the hydraulic cement is selected from the group consisting of portland white cement, slag cement, calcium aluminate cement, silicate cement, phosphate cement, high-alumina cement, magnesium oxychloride cement, aggregates coated with microfine cement particles, MDF cement, DSP cement, and mixtures thereof.
125. A method for manufacturing a sheet as defined in claim 121, wherein the hydraulically settable material comprises calcium sulfate hemihydrate.
126. A method for manufacturing a sheet as defined in claim 121, wherein the hydraulically settable material comprises calcium oxide.
127. A method for manufacturing a sheet having an inorganically filled matrix, the method comprising the steps of:
(a) mixing together water, a water-dispersible organic polymer binder, an inorganic aggregate material, and a fibrous material in order to form an inorganically filled moldable mixture in which the organic polymer binder is substantially solvated in the water, the inorganic aggregate material having a concentration in a range from about 40% to about 98% by volume of total solids in the mixture, the organic polymer binder having a concentration in a range from about 1% to about 50% by volume of total solids in the mixture, the fibrous material having a concentration in a range from about 0.5% to about 50% by volume of total solids in the mixture, and the water having a concentration in a range from about 5% to about 50% by volume of the mixture;
(b) passing the organically filled mixture between forming rollers to form a sheet having a desired thickness; and
(c) evaporating a substantial portion of the water from the sheet to harden the organic polymer binder in less than about 10 minutes after forming the sheet, thereby binding the aggregates and fibers in the sheet, wherein the sheet has a thickness in a range from about 0.01 mm to about 1 cm.
128. A method for manufacturing a sheet as defined in claim 127, wherein the inorganically filled matrix of the sheet has a thickness up to about 3 mm.
129. A method for manufacturing a sheet as defined in claim 127, wherein the inorganically filled matrix of the sheet has a thickness up to about 1 mm.
130. A method for manufacturing a sheet as defined in claim 127, wherein the inorganically filled matrix of the sheet has a density in a range from about 0.4 g/cm.sup.3 to about 1.5 g/cm.sup.3.
131. A method for manufacturing a sheet having an inorganically filled matrix, the method comprising the steps of:
(a) mixing together water, a water-dispersible organic polymer binder, a nonhydraulically-reactive aggregate filler, and a fibrous material to form an inorganically filled mixture in which the organic polymer binder is substantially solvated in the water, the organic polymer binder and fibrous material having a combined concentration in a range from about 5% to about 60% by volume of total solids in an inorganically filled mixture;
(b) passing the inorganically filled mixture between forming rollers to form a sheet having a desired thickness; and
(c) evaporating a substantial portion of the water from the sheet to harden the organic polymer binder in less than about 10 minutes after forming the sheet, thereby binding the aggregates and fibers in the sheet, wherein the sheet has a thickness of less than about 1 cm.
132. A method for manufacturing a sheet having an inorganically filled matrix, the method comprising the steps of:
(a) mixing together water, a water-dispersible organic polymer binder, an inert aggregate material, and a fibrous material to form an inorganically filled mixture in which the organic polymer binder is substantially solvated in the water;
(b) passing the inorganically filled mixture between forming rollers to form a sheet having a thickness less than about 1 mm; and
(c) evaporating a substantial portion of the water from the sheet to harden the organic polymer binder in less than about 10 minutes after forming the sheet, thereby binding the aggregates and fibers in the sheet.
133. A method for manufacturing a sheet having an inorganically filled matrix, the method comprising the steps of:
(a) mixing together water, a water-dispersible organic polymer binder, an aggregate material, and a fibrous material to form an inorganically filled moldable mixture in which the organic polymer binder is substantially solvated in the water, the aggregate material having a concentration in a range from about 40% to about 98% by volume of total

solids in the inorganically filled mixture;
(b) passing the inorganically filled moldable mixture between forming rollers to initially form the moldable mixture into a sheet;
(c) evaporating a substantial portion of the water from the sheet to harden the organic polymer binder in less than about 10 minutes after forming the sheet, thereby binding the aggregates and fibers in the sheet, wherein the sheet has a thickness of less than about 1 cm; and
(d) rolling the sheet obtained from step (c) onto a spool.

134. A method for manufacturing a sheet having an inorganically filled matrix, the method comprising the steps of:
(a) mixing together water, a water-dispersible organic polymer binder, an aggregate material, and a fibrous material to form an inorganically filled moldable mixture in which the organic polymer binder is substantially solvated in the water, the aggregate material having a concentration in a range from about 40% to about 98% by volume of total solids in the inorganically filled mixture;
(b) passing the inorganically filled moldable mixture between forming rollers to initially form the moldable mixture into a sheet;
(c) evaporating a substantial portion of the water from the sheet by passing the sheet obtained in step (b) around a portion of at least one substantially cylindrical drying roller to harden the organic polymer binder in less than about 10 minutes after forming the sheet, thereby binding the aggregates and fibers in the sheet.

L4: Entry 43 of 54 File: USPT May 20, 1997

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INVENTOR-INFORMATION:

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Hodson; Simon K.	Santa Barbara	CA	N/A	N/A

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CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. An article of manufacture comprising a first member hingedly attached to a second member by a hinge, at least a substantial portion of said hinge comprising an inorganically filled matrix including a substantially homogeneous mixture of organic binder and inorganic aggregate, said organic binder being selected from the group consisting of polysaccharides, proteins, and mixture or derivatives thereof, said inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in the matrix, the inorganically filled matrix further including a fibrous material substantially homogeneously dispersed throughout said matrix.
2. An article of manufacture as defined in claim 1, further including a coating material on a surface of said inorganically filled matrix of said hinge.
3. An article of manufacture as defined in claim 2, wherein said coating material renders said inorganically filled matrix more resistant to water penetration.
4. An article of manufacture as defined in claim 2, wherein said coating material renders said inorganically filled matrix more flexible.
5. An article of manufacture as defined in claim 2, wherein said coating material is safe for use with food or beverages.
6. An article of manufacture as defined in claim 2, wherein said coating material comprises a biodegradable material.
7. An article of manufacture as defined in claim 2, wherein said coating material is selected from the group consisting of melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylates, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, edible oils, and mixtures or derivatives thereof.
8. An article of manufacture as defined in claim 2, wherein said coating material is selected from the group consisting of sodium silicate, calcium carbonate, kaolin, silicon oxide, aluminum oxide, ceramic, and mixtures thereof.
9. An article of manufacture as defined in claim 1, wherein said inorganically filled matrix of said hinge further includes a pulp-containing material disposed thereon.
10. An article of manufacture as defined in claim 9, wherein said pulp-containing material is a paper strip.
11. An article of manufacture as defined in claim 1, wherein said first and second members have a mechanical resistance to bending and elongation within a first range and wherein said hinge comprises an area of reduced mechanical resistance to bending and elongation within a second range that is less than the first range of mechanical resistance.
12. An article of manufacture as defined in claim 1, wherein said first and second members have a thickness within a first range and wherein said hinge comprises an area of reduced thickness within a second range that is less than the first range of thickness.
13. An article of manufacture as defined in claim 1, wherein each of said first and second member comprises an inorganically filled matrix comprising a substantially homogenous mixture of a water-dispersible organic binder and an aggregate material.
14. An article of manufacture as defined in claim 1, wherein said inorganically filled

matrix of said hinge has a thickness in a range from about 0.01 mm to about 1 mm.
15. An article of manufacture as defined in claim 1, wherein said hinge is a living hinge.
16. An article of manufacture as defined in claim 1, wherein said inorganically filled matrix of said hinge has a thickness in a range from about 0.05 mm to about 0.5 min.
17. An article of manufacture as defined in claim 1, wherein said inorganic aggregate has a concentration in a range from about 50% to about 95% by volume of total solids in said matrix.
18. An article of manufacture as defined in claim 1, wherein said inorganic aggregate has a concentration in a range from about 60% to about 80% by volume of total solids in said matrix.
19. An article of manufacture as defined in claim 1, wherein said inorganic aggregate comprises a lightweight aggregate selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.
20. An article of manufacture as defined in claim 1, wherein said inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
21. An article of manufacture as defined in claim 1, wherein said inorganically filled matrix further includes an organic aggregate selected from the group consisting of cork, seeds, starches, gelatins, agar materials, and mixtures thereof.
22. An article of manufacture as defined in claim 1, wherein said inorganic aggregate comprises a polymerized silicate.
23. An article of manufacture as defined in claim 1, wherein said organic binder has a concentration in a range from about 1% to about 50% by volume of total solids in said inorganically filled matrix.
24. An article of manufacture as defined in claim 1, wherein said organic binder has a concentration in a range from about 2% to about 30% by volume of total solids in said inorganically filled matrix.
25. An article of manufacture as defined in claim 1, wherein said organic binder has a concentration in a range from about 5% to about 20% by volume of total solids in said inorganically filled matrix.
26. An article of manufacture as defined in claim 1, wherein said organic binder comprises a cellulosic ether selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
27. An article of manufacture as defined in claim 1, wherein said organic binder comprises a starch or derivative thereof selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
28. An article of manufacture as defined in claim 1, wherein said organic binder comprises a protein or derivative thereof selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
29. An article of manufacture as defined in claim 1, wherein said organic binder is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
30. An article of manufacture as defined in claim 1, wherein said inorganically filled matrix further includes a synthetic organic polymer selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
31. An article of manufacture as defined in claim 1, wherein said fibrous material has a concentration in a range from about 0.5% to about 50% by volume of total solids in said inorganically filled matrix.
32. An article of manufacture as defined in claim 1, wherein said fibrous material has a concentration in a range from about 2% to about 30% by volume of total solids in said inorganically filled matrix.
33. An article of manufacture as defined in claim 1, wherein said fibrous material has a concentration in a range from about 5% to about 20% by volume of total solids in said inorganically filled matrix.
34. An article of manufacture as defined in claim 1, wherein said fibrous material comprises organic fibers.
35. An article of manufacture as defined in claim 34, wherein said organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, southern hardwood fibers, and mixtures thereof.
36. An article of manufacture as defined in claim 1, wherein said fibrous material comprises inorganic fibers.
37. An article of manufacture as defined in claim 36, wherein said inorganic fibers are selected from the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.
38. An article of manufacture as defined in claim 1, wherein said fibrous material

includes individual fibers having an aspect ratio greater than about 10:1.
39. An article of manufacture as defined in claim 1, wherein said fibrous material includes individual fibers having an average aspect ratio greater than about 100:1.
40. An article of manufacture as defined in claim 1, wherein said fibrous material comprises individual fibers having a substantially random orientation within said inorganically filled matrix.
41. An article of manufacture as defined in claim 1, wherein said fibrous material comprises individual fibers having a substantially unidirectional orientation within said inorganically filled matrix.
42. An article of manufacture as defined in claim 1, wherein said hinge is formed at least in part by cutting a score in said inorganically filled matrix.
43. An article of manufacture as defined in claim 1, wherein said hinge is formed at least in part by pressing a score in said inorganically filled matrix.
44. An article of manufacture as defined in claim 1, wherein said hinge may be bent up to an angle of about 90.degree. without substantial fracture of said inorganically filled matrix.
45. An article of manufacture as defined in claim 1, wherein said hinge may be bent up to an angle of about 180.degree. without substantial fracture of said inorganically filled matrix.
46. A container comprising a first member hingedly attached to a second member by a hinge, at least a substantial portion of said hinge comprising an inorganically filled matrix including a substantially homogeneous mixture of organic binder and inorganic aggregate, said organic binder being selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof, said inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in said matrix, said inorganically filled matrix further including a fibrous material substantially homogeneously dispersed throughout said matrix.
47. A container as defined in claim 46, wherein said first and second members have a mechanical resistance to bending and elongation within a first range and wherein said hinge comprises an area of reduced mechanical resistance to bending and elongation within a second range that is less than the first range of mechanical resistance.
48. A container as defined in claim 46, wherein said first and second members have a thickness within a first range and wherein said hinge comprises an area of reduced thickness within a second range that is less than the first range of thickness.
49. A container as defined in claim 46, wherein said inorganically filled matrix of said hinge has a thickness in a range from about 0.01 mm to about 1 mm.
50. An article of manufacture as defined in claim 46, wherein said inorganically filled matrix of said hinge further includes a pulp-containing material disposed thereon.
51. An article of manufacture as defined in claim 50, wherein said pulp-containing material is a paper strip.
52. A container as defined in claim 46, further including a coating material on at least a portion of a surface of said inorganically filled matrix.
53. A container as defined in claim 52, wherein said coating material selected from the group consisting of melamine, polyvinylchloride, polyvinylalcohol, polyvinyl acetate, polyacrylates, hydroxypropylmethylcellulose, polyethyleneglycol, acrylics, polyurethane, polylactic acid, starch, soybean protein, polyethylene, synthetic polymers, waxes, elastomers, edible oils, and mixtures or derivatives thereof.
54. A container as defined in claim 52, wherein said coming material is selected from the group consisting of sodium silicate, calcium carbonate, kaoline, silicone oxide, aluminum oxide, ceramic, and mixtures thereof.
55. A container as defined in claim 46, wherein each of said first and second members comprises an inorganically filled matrix comprising a substantially homogeneous mixture of a water-dispersible organic binder and an organic material.
56. A container as defined in claim 46, wherein said hinge is a living hinge.
57. A container as defined in claim 46, wherein said inorganic aggregate has a concentration in a range from about 50% to about 95% by volume of total solids in said matrix.
58. A container as defined in claim 46, wherein said inorganic aggregate has a concentration in range from about 60% to about 80% by volume of total solids in said matrix.
59. A container as defined in claim 46, wherein said inorganic aggregate comprises a lightweight aggregate selected from a group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologically materials, pumice, and mixtures thereof.
60. A container as defined in claim 46, wherein said inorganic aggregate is selected from a group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
61. A container as defined in claim 46, wherein said organic binder has a concentration in a range from about 1% to about 5.0% percent by volume of total solids in said inorganically filled matrix.
62. A container as defined in claim 46, wherein said organic binder has a concentration in a range from about 2% to about 30% by volume of total solids in said inorganically filled matrix.
63. A container as defined in claim 46, wherein said organic binder has a concentration

in a range from about 5% to about 20% by volume of total solids in said inorganically filled matrix.
64. A container as defined in claim 46, wherein said organic binder comprises cellulosic ether selected from a group of methylhydroxylethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivative thereof.
65. A container as defined in claim 46, wherein said organic binder comprises a starch selected from the group consisting of amylopectin, amylose, sea gel, starch acetates, starch hydroxyethylethers, ionic starches, long-chain alkyl starches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
66. A container as defined in claim 46, wherein said organic binder comprises a protein selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
67. A container as defined in claim 46, wherein said organic binder is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
68. A container as defined in claim 46, wherein said fibrous material has a concentration in a range from about 0.5% to about 50% by volume of total solids in said inorganically filled matrix.
69. A container as defined in claim 46, wherein said fibrous material has a concentration in a range from about 2% to about 30% by volume of total solids in said inorganically filled matrix.
70. A container as defined in claim 46, wherein said fibrous material has a concentration in a range from about 5% to about 20% by volume of total solids in said inorganically filled matrix.
71. A container as defined in claim 46, wherein said fibrous material comprises organic fibers.
72. A container as defined in claim 71, wherein said organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, southern hardwood fibers, and mixtures thereof.
73. A container as defined in claim 46, wherein said fibrous material comprises inorganic fibers.
74. A container as defined in claim 73, wherein said inorganic fibers are selected from the group consisting of glass, fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.
75. A container as defined in claim 46, wherein said fibrous material includes individual fibers having an aspect ratio greater than about 10:1.
76. A container as defined in claim 46, wherein said hinge is formed at least in part by pressing a score in said inorganically filled matrix.
77. An article of manufacture comprising a first member hingedly attached to a second member by a hinge, at least a substantial portion of said hinge comprising an inorganically filled matrix including a substantially homogeneous mixture of organic binder and inorganic aggregate, said inorganically filled matrix being formed by removing a substantial quantity of water by evaporation from an inorganically filled mixture comprising an organic binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof, water, an inorganic aggregate material having a concentration in a range from about 40% to about 95% by weight of total solids in said mixture, and fibers substantially homogeneously dispersed throughout said mixture.
78. An article of manufacture as defined in claim 77, further including a coating material on at least a portion of a surface of said inorganically filled matrix.
79. An article of manufacture as defined in claim 78, wherein said coating material selected from the group consisting of melamine, polyvinylchloride, polyvinylalcohol, polyvinyl acetate, polyacrylates, hydroxypropylmethylcellulose, polyethyleneglycol, acrylics, polyurethane, polylactic acid, starch, soybean protein, polyethylene, synthetic polymers, waxes, elastomers, edible oils, and mixtures or derivatives thereof.
80. An article of manufacture as defined in claim 78, wherein said coating material is selected from the group consisting of sodium silicate, calcium carbonate, kaoline, silicone oxide, aluminum oxide, ceramic, and mixtures thereof.
81. An article of manufacture as defined in claim 77, wherein each of said first and second members comprises an inorganically filled matrix comprising a substantially homogeneous mixture of a water-dispersible organic binder and an organic material.
82. An article of manufacture as defined in claim 77, wherein said hinge is a living hinge.
83. An article of manufacture as defined in claim 77, wherein said inorganic aggregate has a concentration in range from about 50% to about 95% by volume of total solids in said mixture.
84. An article of manufacture as defined in claim 77, wherein said inorganic aggregate has a concentration in range from about 60% to about 80% by volume of total solids in said mixture.
85. An article of manufacture as defined in claim 77, wherein said inorganic aggregate comprises a lightweight aggregate selected from a group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologically materials, pumice, and mixtures thereof.

86. An article of manufacture as defined in claim 77, wherein said inorganic aggregate is selected from a group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
87. An article of manufacture as defined in claim 77, wherein said organic binder has a concentration in a range from about 1% to about 50% percent by volume of total solids in said inorganically filled mixture.
88. An article of manufacture as defined in claim 77, wherein said organic binder has a concentration in a range from about 2% to about 30% by volume of total solids in said inorganically filled mixture.
89. An article of manufacture as defined in claim 77, wherein said organic binder has a concentration in a range from about 5% to about 20% by volume of total solids in said inorganically filled mixture.
90. An article of manufacture as defined in claim 77, wherein said organic binder comprises cellulosic ether selected from a group of methylhydroxylethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivative thereof.
91. An article of manufacture as defined in claim 77, wherein said organic binder comprises a starch selected from the group consisting of amylopectin, amylose, sea gel, starch acetates, starch hydroxyethylethers, ionic starches, long-chain alkyl starches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
92. An article of manufacture as defined in claim 77, wherein said organic binder comprises a protein selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
93. An article of manufacture as defined in claim 77, wherein said organic binder is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
94. An article of manufacture as defined in claim 77, wherein said fibers have a concentration in a range from about 0.5% to about 50% by volume of total solids in said inorganically filled mixture.
95. An article of manufacture as defined in claim 77, wherein said fibers have a concentration in a range from about 2% to about 30% by volume of total solids in said inorganically filled mixture.
96. An article of manufacture as defined in claim 77, wherein said fibers have a concentration in a range from about 5% to about 20% by volume of total solids in said inorganically filled mixture.
97. An article of manufacture as defined in claim 77, wherein said fibers comprise organic fibers.
98. An article of manufacture as defined in claim 97, wherein said organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, southern hardwood fibers, and mixtures thereof.
99. An article of manufacture as defined in claim 77, wherein said fibers comprise inorganic fibers.
100. An article of manufacture as defined in claim 99, wherein said inorganic fibers are selected from the group consisting of glass, fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.
101. An article of manufacture as defined in claim 77, wherein said fibers have an aspect ratio greater than about 10:1.
102. An article of manufacture as defined in claim 77, wherein said hinge is formed at least in part by pressing a score in said inorganically filled matrix.
103. An article of manufacture as defined in claim 77, wherein said inorganically filled matrix of said hinge further includes a pulp-containing material disposed thereon.
104. An article of manufacture as defined in claim 103, wherein said pulp-containing material comprises a paper strip.

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TITLE: Inorganically filled, starch-bound compositions for manufacturing containers and other articles having a thermodynamically controlled cellular matrix

DATE-ISSUED: August 26, 1997

INVENTOR-INFORMATION:

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CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. An article of manufacture comprising a starch-bound cellular matrix of starch and inorganic aggregate, the starch-bound cellular matrix comprising:
a starch-based binder that has been substantially gelatinized by water and then hardened through the removal of a substantial quantity of the water by evaporation; and
an inorganic aggregate dispersed throughout the starch-bound cellular matrix in a concentration in a range from about 20% to about 90% by weight of total solids within the starch-bound cellular matrix,
wherein the starch-bound cellular matrix has a thickness less than about 1 cm and degrades after prolonged exposure to water.
2. An article of manufacture as defined in claim 1, wherein the starch-based binder includes a potato starch.
3. An article of manufacture as defined in claim 1, wherein the starch-based binder includes a wheat starch.
4. An article of manufacture as defined in claim 1, wherein the starch-based binder is selected from the group consisting of starches derived from cereals, tubers, roots, and mixtures thereof.
5. An article of manufacture as defined in claim 1, wherein the starch-based binder is derived from a grain flour.
6. An article of manufacture as defined in claim 1, wherein the starch-based binder includes a plurality of different types of starches.
7. An article of manufacture as defined in claim 1, wherein the starch-based binder includes a modified starch.
8. An article of manufacture as defined in claim 1, wherein the starch-based binder is included in an amount in a range from about 10% to about 80% by weight of total solids within the starch-bound cellular matrix.
9. An article of manufacture as defined in claim 1, wherein the starch-based binder is included in an amount in a range from about 30% to about 70% by weight of total solids within the starch-bound cellular matrix.
10. An article of manufacture as defined in claim 1, wherein the starch-based binder is included in an amount in a range from about 40% to about 60% by weight of total solids within the starch-bound cellular matrix.
11. An article of manufacture as defined in claim 1, wherein the inorganic aggregate includes calcium carbonate.
12. An article of manufacture as defined in claim 1, wherein the inorganic aggregate includes sand.
13. An article of manufacture as defined in claim 1, wherein the inorganic aggregate includes a plurality of different kinds of aggregates.
14. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of sandstone, glass beads, mica, clay, kaolin, limestone, silica, fused silica, alumina, and mixtures thereof.
15. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is

selected from the group consisting of perlite, vermiculite, hollow glass spheres, aerogel, exfoliated rock, and mixtures thereof.
16. An article of manufacture as defined in claim 1, wherein the inorganic aggregate imparts a color to the mixture.
17. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a specific surface area in a range from about 0.1 m.sup.2 /g to about 400 m.sup.2 /g.
18. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a specific surface area in a range from about 0.15 m.sup.2 /g to about 50 m.sup.2 /g.
19. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a specific surface area in a range from about 0.2 m.sup.2 /g to about 2 m.sup.2 /g.
20. An article of manufacture as defined in claim 1, wherein the inorganic aggregate includes a lightweight aggregate which lowers the thermal conductivity of the article.
21. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is included in an amount in a range from about 30% to about 70% by weight of total solids within the starch-bound cellular matrix.
22. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is included in an amount in a range from about 40% to about 60% by weight of total solids within the starch-bound cellular matrix.
23. An article of manufacture as defined in claim 1, wherein the article has a specific heat in a range from about 0.1 J/g.multidot.K to about 400 J/g.multidot.K at 20.degree. C.
24. An article of manufacture as defined in claim 1, wherein the article has a specific heat in a range between about 0.15 J/g.multidot.K to about 50 J/g.multidot.K at 20.degree. C.
25. An article of manufacture as defined in claim 1, wherein the article has a specific heat in a range between about 0.2 J/g.multidot.K to about 20 J/g.multidot.K at 20.degree. C.
26. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix further includes a mold-releasing agent.
27. An article of manufacture as defined in claim 26, wherein the mold-releasing agent includes a fatty acid having a carbon chain greater than about C.sub.12.
28. An article of manufacture as defined in claim 26, wherein the mold-releasing agent includes a salt of a fatty acid.
29. An article of manufacture as defined in claim 26, wherein the mold-releasing agent includes an acid derivative of a fatty acid.
30. An article of manufacture as defined in claim 26, wherein the mold-releasing agent includes magnesium stearate.
31. An article of manufacture as defined in claim 26, wherein the mold-releasing agent includes a wax.
32. An article of manufacture as defined in claim 26, wherein the mold-releasing agent is included in an amount in a range from about 0.5% to about 10% by weight of total solids within the starch-bound cellular matrix.
33. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix further includes fibers dispersed therein.
34. An article of manufacture as defined in claim 33, wherein the fibers are included in an amount in a range from about 0.5% to about 60% by volume of solids within the starch-bound cellular matrix.
35. An article of manufacture as defined in claim 33, wherein the fibers are included in an amount in a range from about 2% to about 40% by volume of solids within the starch-bound cellular matrix.
36. An article of manufacture as defined in claim 33, wherein the fibers are included in an amount in a range from about 5% to about 20% by volume of solids within the starch-bound cellular matrix.
37. An article of manufacture as defined in claim 33, wherein the fibers includes sisal fibers.
38. An article of manufacture as defined in claim 33, wherein the fibers are selected from the group consisting of fibers derived from hemp, cotton, plant, leaves, abaca, bagasse, wood, and mixtures thereof.
39. An article of manufacture as defined in claim 33, wherein the fibers are selected from the group of fibers consisting of glass, graphite, silica, ceramic, metals, and mixtures thereof.
40. An article of manufacture as defined in claim 33, wherein the fibers have an average diameter in a range from about 10 .mu.m to about 100 .mu.m.
41. An article of manufacture as defined in claim 33, wherein the fibers have an average diameter in a range from about 50 .mu.m to about 100 .mu.m.
42. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix further includes a rheology-modifying agent.
43. An article of manufacture as defined in claim 42, wherein the rheology-modifying agent includes a cellulose-based material.
44. An article of manufacture as defined in claim 43, wherein the cellulose-based material is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, hydroxypropylmethylcellulose, and mixtures or derivatives thereof.

45. An article of manufacture as defined in claim 42, wherein the rheology-modifying agent includes a polysaccharide-based material.
46. An article of manufacture as defined in claim 45, wherein the polysaccharide-based material is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
47. An article of manufacture as defined in claim 42, wherein the rheology-modifying agent includes a protein-based material.
48. An article of manufacture as defined in claim 47, wherein the protein-based material is selected from a group consisting of prolamine, collagen, casein, and mixtures or derivatives thereof.
49. An article of manufacture as defined in claim 42, wherein the rheology-modifying agent includes a synthetic organic material.
50. An article of manufacture as defined in claim 49, wherein the synthetic organic material is selected from the group consisting of polyethylene glycol, polyvinyl alcohol, polyvinyl acetate, polyacrylic acids, polylactic acid, and mixtures or derivatives thereof.
51. An article of manufacture as defined in claim 42, wherein the rheology-modifying agent is included in an mount in a range from about 0.5% to about 10% by weight of total solids within the starch-bound cellular matrix.
52. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix further includes a dispersant.
53. An article of manufacture as defined in claim 52, wherein the dispersant is selected from the group consisting of sulphonated melamine-formaldehyde condensate, lignosulfonate, and polyacrylic acid.
54. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix further includes an enzyme.
55. An article of manufacture as defined in claim 54, wherein the enzyme is selected from the group consisting of carbohydrases, amylase, oxidase, and mixtures or derivatives thereof.
56. An article of manufacture as defined in claim 54, wherein the enzyme is included in an amount in a range from about 0.5% to about 10% by weight of total solids within the starch-bound cellular matrix.
57. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix further includes a humectant for maintaining moisture within the cellular matrix and increasing the flexibility of the article.
58. An article of manufacture as defined in claim 57, wherein the humectant is selected from the group consisting of MgCl.sub.2, CaCl.sub.2, NaCl, calcium citrate, and mixtures thereof.
59. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix includes a cross-linking material.
60. An article of manufacture as defined in claim 59, wherein the cross-linking material is selected from the group consisting of dialdehydes, methylureas, melamine formaldehyde resins, and mixtures or derivatives thereof.
61. An article of manufacture as defined in claim 59, wherein the cross-linking material is included in an amount in a range from about 0.5% to about 5% by weight of total solids within the starch-bound cellular matrix.
62. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix has a density in a range from about 0.05 g/cm.sup.3 to about 1 g/cm.sup.3.
63. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix has a density in a range from about 0.1 g/cm.sup.3 to about 0.5 g/cm.sup.3.
64. An article of manufacture as defined in claim 1, wherein the article comprises a container.
65. An article of manufacture as defined in claim 64, wherein the container is a cup.
66. An article of manufacture as defined in claim 64, wherein the container is a plate.
67. An article of manufacture as defined in claim 64, wherein the container is a clam-shell.
68. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix has a thickness in a range from about 0.5 mm to about 6 mm.
69. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix has a thickness in a range from about 1 mm to about 3 mm.
70. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix further includes a coating on at least a portion of a surface thereof.
71. An article of manufacture as defined in claim 70, wherein the coating includes a wax.

72. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix further includes a plasticizer that imparts flexibility to the article.
73. An article of manufacture as defined in claim 72, wherein the plasticizer comprises glycerin.
74. An article of manufacture as defined in claim 72, wherein the plasticizer is selected from the group consisting of monoglycerides, diglycerides, polyethylene glycol, sorbitol, and mixtures or derivatives thereof.
75. An article of manufacture as defined in claim 1, wherein the inorganic aggregate includes a porous inorganic aggregate capable of absorbing water during molding of the

article and thereafter releasing the water into the starch-bound cellular matrix after the article has been molded.
76. An article of manufacture as defined in claim 1, wherein the article has a thermal resistance in a range from about 0.04 W/m.multidot.K to about 0.2 W/m.multidot.K.
77. An article of manufacture as defined in claim 1, wherein the article has a thermal resistance in a range from about 0.04 W/m.multidot.K to about 0.06 W/m.multidot.K.
78. An article of manufacture as defined in claim 1, wherein the starch-bound cellular matrix further includes an inert organic aggregate.
79. An article of manufacture as defined in claim 78, wherein the inert organic aggregate is selected from the group consisting of seeds, grains, cork, plastic spheres, and mixtures thereof.
80. An article of manufacture as defined in claim 78, wherein the inert organic aggregate is included in an amount in a range from about 5% to about 60% by weight of total solids in starch-bound cellular matrix.
81. An article of manufacture as defined in claim 78, wherein the inert organic aggregate is included in an amount in a range from about 15% to about 50% by weight of total solids in the starch-bound cellular matrix.
82. An article of manufacture as defined in claim 78, wherein the inert organic aggregate is included in an amount in a range from about 25% to about 40% by weight of total solids in the starch-bound cellular matrix.
83. An article of manufacture comprising a starch-bound cellular matrix of starch and inorganic aggregate reinforced with fibers, the starch-bound cellular matrix comprising:
a starch-based binder that has been substantially gelatinized by water and then hardened through the removal of a substantial quantity of the water by evaporation;
an inorganic aggregate dispersed throughout the starch-bound cellular matrix and included in an amount in a range from about 20% to about 90% by weight of solids within the starch-bound cellular matrix; and
fibers dispersed throughout the starch-bound cellular matrix and included in an amount in a range from about 2% to about 40% by volume of solids within the starch-bound cellular matrix,
wherein the starch-bound cellular matrix has a thickness less than about 6 mm and degrades after prolonged exposure to water.
84. An article of manufacture as defined in claim 83, further including a coating on at least a portion of the article.
85. An article of manufacture as defined in claim 83, wherein the starch-bound cellular matrix further includes glycerin.
86. An article of manufacture as defined in claim 83, wherein the starch-bound cellular matrix further includes a material selected from the group consisting of polyethylene glycol, polyvinyl alcohol, polyvinyl acetate, polyacrylic acids, polylactic acid, sorbitol, and mixtures or derivatives thereof.
87. An article of manufacture as defined in claim 83, wherein the starch-based binder includes a potato starch.
88. An article of manufacture as defined in claim 83, wherein the starch-based binder includes a modified starch.
89. An article of manufacture as defined in claim 83, wherein the starch-based binder is included in an amount in a range from about 10% to about 80% by weight of total solids within the starch-bound cellular matrix.
90. An article of manufacture as defined in claim 83, wherein the starch-based binder is included in an amount in a range from about 30% to about 70% by weight of total solids within the starch-bound cellular matrix.
91. An article of manufacture as defined in claim 83, wherein the starch-based binder is included in an amount in a range from about 40% to about 60% by weight of total solids within the starch-bound cellular matrix.
92. An article of manufacture as defined in claim 83, wherein the inorganic aggregate includes calcium carbonate.
93. An article of manufacture as defined in claim 83, wherein the inorganic aggregate includes sand.
94. An article of manufacture as defined in claim 83, wherein the inorganic aggregate is included in an amount in a range from about 30% to about 70% by weight of total solids within the starch-bound cellular matrix.
95. An article of manufacture as defined in claim 83, wherein the inorganic aggregate is included in an amount in a range from about 40% to about 60% by weight of total solids within the starch-bound cellular matrix.
96. An article of manufacture as defined in claim 83, wherein the starch-bound cellular matrix further includes a mold-releasing agent.
97. An article of manufacture as defined in claim 94, wherein the mold-releasing agent includes magnesium stearate.
98. An article of manufacture as defined in claim 83, wherein said fibers are substantially homogeneously dispersed.
99. An article of manufacture as defined in claim 83, wherein the fibers are included in an amount in a range from about 0.5% to about 60% by volume of solids within the starch-bound cellular matrix.
100. An article of manufacture as defined in claim 83, wherein the fibers are included in an amount in a range from about 2% to about 40% by volume of solids within the

starch-bound cellular matrix.
101. An article of manufacture as defined in claim 83, wherein the fibers are included in an amount in a range from about 5% to about 20% by volume of solids within the starch-bound cellular matrix.
102. An article of manufacture as defined in claim 83, wherein the fibers are selected from the group consisting of fibers derived from sisal, hemp, cotton, plant, leaves, abaca, bagasse, wood, and mixtures thereof.
103. An article of manufacture as defined in claim 83, wherein the fibers are selected from the group of fibers consisting of glass, graphite, silica, ceramic, metals, and mixtures thereof.
104. An article of manufacture as defined in claim 83, wherein the starch-bound cellular matrix further includes a material selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
105. An article of manufacture as defined in claim 83, wherein the starch-bound cellular matrix further includes a material selected from a group consisting of prolamine, collagen, casein, and mixtures or derivatives thereof.
106. An article of manufacture as defined in claim 83, wherein the starch-bound cellular matrix further includes a material selected from the group consisting of polyethylene glycol, polyvinyl alcohol, polyvinyl acetate, polyacrylic acids, polylactic acid, and mixtures or derivatives thereof.
107. An article of manufacture as defined in claim 83, wherein the starch-bound cellular matrix has a density in a range from about 0.05 g/cm.sup.3 to about 1 g/cm.sup.3.
108. An article of manufacture as defined in claim 83, wherein the starch-bound cellular matrix has a density in a range from about 0.1 g/cm.sup.3 to about 0.5 g/cm.sup.3.
109. An article of manufacture as defined in claim 83, wherein the article comprises a container.
110. An article of manufacture as defined in claim 109, wherein the container is a cup.
111. An article of manufacture as defined in claim 109, wherein the container is a plate.

112. An article of manufacture as defined in claim 109, wherein the container is a clam-shell.
113. An article of manufacture as defined in claim 83, wherein the starch-bound cellular matrix has a thickness in a range from about 1 mm to about 3 mm.
114. An article of manufacture as defined in claim 84, wherein the coating includes a wax.
115. An article of manufacture comprising a starch-bound cellular matrix of starch and inorganic aggregate reinforced with fibers, the starch-bound cellular matrix comprising:
a starch binder selected from the group consisting of potato starch, corn starch, and waxy corn starch, the starch binder having been substantially gelatinized by water and then hardened through the removal of a substantial quantity of the water by evaporation, the starch binder having a concentration in a range from about 30% to about 70% by weight of solids within the starch-bound cellular matrix;
an inorganic aggregate dispersed throughout the starch-bound cellular matrix and included in an amount in a range from about 30% to about 70% by weight of solids within the starch-bound cellular matrix; and
organic fibers dispersed throughout the starch-bound cellular matrix and included in an amount up to about 20% by volume of solids within the starch-bound cellular matrix, wherein the starch-bound cellular matrix has a thickness less than about 6 mm and degrades after prolonged exposure to water.
116. An article of manufacture as defined in claim 115, further including a coating on at least a portion of the article.
117. An article of manufacture as defined in claim 115, wherein the starch-bound cellular matrix farther includes glycerin.
118. An article of manufacture as defined in claim 115, wherein the starch-bound cellular matrix further includes a material selected from the group consisting of polyethylene glycol, polyvinyl alcohol, polyvinyl acetate, polyacrylic acids, polylactic acid, sorbitol, and mixtures or derivatives thereof.
119. An article of manufacture as defined in claim 115, wherein the starch-based binder includes a modified starch.
120. An article of manufacture as defined in claim 115, wherein the starch-based binder is included in an amount in a range from about 40% to about 60% by weight of total solids within the starch-bound cellular matrix.
121. An article of manufacture as defined in claim 115, wherein the inorganic aggregate includes calcium carbonate.
122. An article of manufacture as defined in claim 115, wherein the inorganic aggregate includes sand.
123. An article of manufacture as defined in claim 115, wherein the inorganic aggregate is included in an amount in a range from about 40% to about 60% by weight of total solids within the starch-bound cellular matrix.
124. An article of manufacture as defined in claim 115, wherein the starch-bound cellular matrix further includes a mold-releasing agent.
125. An article of manufacture as defined in claim 124, wherein the mold-releasing agent includes magnesium stearate.

126. An article of manufacture as defined in claim 115, wherein the fibers are selected from the group consisting of fibers derived from sisal, hemp, cotton, plant, leaves, abaca, bagasse, wood, and mixtures thereof.
127. An article of manufacture as defined in claim 115, wherein the fibers are selected from the group of fibers consisting of glass, graphite, silica, ceramic, metals, and mixtures thereof.
128. An article of manufacture as defined in claim 115, wherein the starch-bound cellular matrix further includes a material selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
129. An article of manufacture as defined in claim 115, wherein the starch-bound cellular matrix further includes a material selected from a group consisting of prolamine, collagen, casein, and mixtures or derivatives thereof.
130. An article of manufacture as defined in claim 115, wherein the starch-bound cellular matrix further includes a material selected from the group consisting of polyethylene glycol, polyvinyl alcohol, polyvinyl acetate, polyacrylic acids, polylactic acid, and mixtures or derivatives thereof.
131. An article of manufacture as defined in claim 115, wherein the starch-bound cellular matrix has a density in a range from about 0.05 g/cm.sup.3 to about 1 g/cm.sup.3.
132. An article of manufacture as defined in claim 115, wherein the starch-bound cellular matrix has a density in a range from about 0.1 g/cm.sup.3 to about 0.5 g/cm.sup.3.
133. An article of manufacture as defined in claim 115, wherein the article comprises a container.
134. An article of manufacture as defined in claim 133, wherein the container is a cup.
135. An article of manufacture as defined in claim 133, wherein the container is a plate.

136. An article of manufacture as defined in claim 133, wherein the container is a clam-shell.
137. An article of manufacture as defined in claim 115, wherein the starch-bound cellular matrix has a thickness in a range from about 1 mm to about 3 mm.
138. An article of manufacture as defined in claim 116, wherein the coating includes a wax.
139. An article of manufacture comprising a starch-bound cellular matrix of starch and inorganic aggregate, the starch-bound cellular matrix comprising:
a starch-based binder that has been substantially gelatinized by water and then hardened through the removal of a substantial quantity of the water by evaporation; and
an inorganic aggregate dispersed throughout the starch-bound cellular matrix in a concentration in a range from about 20% to about 90% by weight of total solids within the starch-bound cellular matrix,
wherein the starch-bound cellular matrix has a thickness less than about 1 cm and degrades after prolonged exposure to water, wherein the article includes a coating on at least a portion thereof.
140. An article of manufacture as defined in claim 139, wherein the starch-based binder includes a potato starch.
141. An article of manufacture as defined in claim 139, wherein the starch-based binder includes a modified starch.
142. An article of manufacture as defined in claim 139, wherein the inorganic aggregate includes calcium carbonate.
143. An article of manufacture as defined in claim 139, wherein the inorganic aggregate is included in an amount in a range from about 30% to about 70% by weight of total solids within the starch-bound cellular matrix.
144. An article of manufacture as defined in claim 139, wherein the inorganic aggregate is included in an amount in a range from about 40% to about 60% by weight of total solids within the starch-bound cellular matrix.
145. An article of manufacture as defined in claim 139, wherein the fibers are selected from the group consisting of fibers derived from sisal, hemp, cotton, plant, leaves, abaca, bagasse, wood, and mixtures thereof.
146. An article of manufacture as defined in claim 139, wherein the starch-bound cellular matrix further includes a material selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
147. An article of manufacture as defined in claim 139, wherein the starch-bound cellular matrix has a thickness in a range from about 1 mm to about 3 mm.
148. An article of manufacture as defined in claim 139, wherein the coating includes a wax.
149. An article of manufacture as defined in claim 139, wherein the starch-bound cellular matrix further includes glycerin within a portion thereof.
150. An article of manufacture comprising a starch-bound cellular matrix of starch and inorganic aggregate reinforced with fibers, the starch-bound cellular matrix comprising:
a starch-based binder that has been substantially gelatinized by water and then hardened through the removal of a substantial quantity of the water by evaporation;
an inorganic aggregate dispersed throughout the starch-bound cellular matrix and included in an amount in a range from about 20% to about 90% by weight of solids within the starch-bound cellular matrix; and

fibers dispersed throughout the starch-bound cellular matrix and included in an amount in a range from about 2% to about 40% by volume of solids within the starch-bound cellular matrix,
wherein the starch-bound cellular matrix has a thickness less than about 6 mm, includes glycerin within a portion thereof, and degrades after prolonged exposure to water.
151. An article of manufacture as defined in claim 150, wherein the starch-bound cellular matrix further includes a coating material on at least a portion thereof.
152. An article of manufacture as defined in claim 151, wherein the coating includes a wax.
153. An article of manufacture as defined in claim 150, wherein the inorganic aggregate includes calcium carbonate.
154. An article of manufacture comprising a starch-bound cellular matrix of starch and inorganic aggregate reinforced with fibers, the starch-bound cellular matrix comprising:
a starch binder selected from the group consisting of potato starch, corn starch, and waxy corn starch, the starch binder having been substantially gelatinized by water and then hardened through the removal of a substantial quantity of the water by evaporation, the starch binder having a concentration in a range from about 30% to about 70% by weight of solids within the starch-bound cellular matrix;
calcium carbonate dispersed throughout the starch-bound cellular matrix and included in an amount in a range from about 30% to about 70% by weight of solids within the starch-bound cellular matrix; and
organic fibers dispersed throughout the starch-bound cellular matrix and included in an amount up to about 20% by volume of solids within the starch-bound cellular matrix,
wherein the starch-bound cellular matrix has a thickness less than about 6 mm and degrades after prolonged exposure to water, wherein the article includes a coating on at least a portion thereof.
155. An article of manufacture as defined in claim 154, wherein the starch-bound cellular matrix further includes glycerin within a portion thereof.
156. An article of manufacture as defined in claim 154, wherein the coating includes a wax.
157. An article of manufacture as defined in claim 154, wherein the starch-bound cellular matrix has a thickness less than about 3 mm.

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L5: Entry 33 of 46 File: USPT Aug 26, 1997

US-PAT-NO: 5660903
DOCUMENT-IDENTIFIER: US 5660903 A

TITLE: Sheets having a highly inorganically filled organic polymer matrix

DATE-ISSUED: August 26, 1997

INVENTOR-INFORMATION:

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US-CL-CURRENT: 428/36.4; 428/152, 428/182, 428/317.9, 428/339, 428/43, 428/532, 428/906

CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. A sheet comprising an inorganically filled matrix including a substantially homogeneous mixture of organic binder and inorganic aggregate, and a fibrous material substantially homogeneously dispersed throughout the inorganically filled matrix, the organic binder being selected from the group consisting of polysaccarides, proteins, and mixtures or derivatives thereof, the inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in the sheet, wherein the inorganically filled matrix has a thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water.
2. A sheet as defined in claim 1, the inorganic aggregate having a concentration in a range from about 50% to about 90% by weight of total solids in the inorganically filled matrix.
3. A sheet as defined in claim 1, the inorganic aggregate having a concentration in a range from about 60% to about 80% by weight of the total solids in the inorganically filled matrix.
4. A sheet as defined in claim 1, wherein the inorganic aggregate comprises at least two different aggregate materials.
5. A sheet as defined in claim 1, wherein the inorganic aggregate comprises individual particles that are size optimized in order to achieve a predetermined particle packing density of the aggregate.
6. A sheet as defined in claim 5, wherein the particle packing density of the aggregate is at least about 0.65.
7. A sheet as defined in claim 5, wherein the particle packing density of the aggregate is at least about 0.75.
8. A sheet as defined in claim 5, wherein the particle packing density of the aggregate is at least about 0.85.
9. A sheet as defined in claim 1, wherein the inorganic aggregate comprises a lightweight aggregate selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.
10. A sheet as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
11. A sheet as defined in claim 1, wherein the inorganically filled matrix further includes an organic aggregate selected from the group consisting of seeds, starch granules, gelatins, agar materials, and mixtures thereof.
12. A sheet as defined in claim 1, wherein the inorganic aggregate includes an inorganic gel.
13. A sheet as defined in claim 1, wherein the inorganic aggregate includes an inorganic material that is precipitated in situ.
14. A sheet as defined in claim 1, wherein the inorganic aggregate comprises a polymerized silicate.
15. A sheet as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 3 mm.

16. A sheet as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 1 mm.
17. A sheet as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 0.5 mm.
18. A sheet as defined in claim 1, wherein the organic binder has a concentration in a range from about 1% to about 50% by volume of total solids in the inorganically filled matrix.
19. A sheet as defined in claim 1, wherein the organic binder has a concentration in a range from about 2% to about 30% by volume of total solids in the inorganically filled matrix.
20. A sheet as defined in claim 1, wherein the organic binder has a concentration in a range from about 5% to about 20% by volume of total solids in the inorganically filled matrix.
21. A sheet as defined in claim 1, wherein the organic binder comprises a cellulosic material.
22. A sheet as defined in claim 21, wherein the cellulosic material is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
23. A sheet as defined in claim 1, wherein the organic binder comprises a starch or a derivative thereof.
24. A sheet as defined in claim 23, wherein the starch or derivative thereof is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
25. A sheet as defined in claim 1, wherein the protein or derivative thereof is selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
26. A sheet as defined in claim 1, wherein the polysaccharide or derivative thereof is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
27. A sheet as defined in claim 1, further including a synthetic organic polymer dispersed throughout the inorganically filled matrix.
28. A sheet as defined in claim 27, wherein the synthetic organic polymer is selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
29. A sheet as defined in claim 1, wherein the fibrous material has a concentration up to about 50% by volume of total solids in the inorganically filled matrix.
30. A sheet as defined in claim 29, wherein the fibrous material has a concentration in a range from about 5% to about 40% by volume of total solids in the inorganically filled matrix.
31. A sheet as defined in claim 29, wherein the fibrous material has a concentration in a range from about 15% to about 30% by volume of total solids in the inorganically filled matrix.
32. A sheet as defined in claim 29, wherein the fibrous material comprises organic fibers.
33. A sheet as defined in claim 32, wherein the organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, and southern hardwood fibers, and mixtures thereof.
34. A sheet as defined in claim 29, wherein the fibrous material comprises inorganic fibers.
35. A sheet as defined in claim 34, wherein the inorganic fibers are selected from the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.
36. A sheet as defined in claim 29, wherein the fibrous material comprises a mixture of different fibers having varying strengths and flexibilities.
37. A sheet as defined in claim 29, wherein the fibrous material includes individual fibers having an aspect ratio greater than about 10:1.
38. A sheet as defined in claim 29, wherein the fibrous material includes individual fibers having an average aspect ration of at least about 100:1.
39. A sheet as defined in claim 1, wherein the fibrous material includes individual fibers having an average aspect ration of at least about 1000:1.
40. A sheet as defined in claim 1, further including a coating material on a surface of the inorganically filled matrix.
41. A sheet as defined in claim 1, wherein the sheet has a tensile strength in a range from about 0.05 MPa to about 70 MPa.
42. A sheet as defined in claim 1, wherein the sheet has a tensile strength in a range from about 5 MPa to about 40 MPa.
43. A sheet as defined in claim 1, wherein the inorganically filled matrix further includes a hydraulically settable material.
44. A sheet as defined in claim 43, wherein the hydraulically settable material is selected from the group consisting of a hydraulic cement, calcium oxide, and mixtures or

derivatives thereof.
45. A sheet as defined in claim 44, wherein the hydraulically settable material has a concentration great enough to impart a binding effect within the inorganically filled matrix.
46. A sheet as defined in claim 1, wherein the inorganically filled matrix has a maximum bulk density of about 2 g/cm.sup.3.
47. A sheet as defined in claim 1, wherein the sheet is laminated together with at least one other sheet.
48. A sheet as defined in claim 47, wherein the at least one other sheet also includes an inorganically filled matrix.
49. A sheet as defined in claim 47, wherein the at least one other sheet is selected from the group consisting of organic polymer sheets, metal foils, fiber sheets, ceramic sheets, ionomers, elastomeric sheets, plastic sheets, cellophane sheets, nylon sheets, wax sheets, metallized films, and combinations of the foregoing.
50. A sheet as defined in claim 1, wherein the sheet is corrugated.
51. A sheet as defined in claim 1, wherein the sheet is creped.
52. A sheet as defined in claim 1, wherein the sheet includes an imprint.
53. A sheet as defined in claim 1, wherein the sheet includes a score cut.
54. A sheet as defined in claim 1, wherein the sheet includes a score.
55. A sheet as defined in claim 1, wherein the sheet includes a perforation.
56. A sheet as defined in claim 1, wherein the organic binder, inorganic aggregate, and fibrous material are initially dispersed in water to form an aqueous inorganically filled mixture, the inorganically filled matrix formed by removing a substantial portion of the water from the inorganically filled mixture.
57. A sheet as defined in claim 56, wherein the water has a concentration in a range from about 5% to about 50% by volume of the inorganically filled mixture.
58. A sheet as defined in claim 1, wherein the inorganically filled matrix includes finely dispersed air voids.
59. A sheet as defined in claim 1, wherein the fibrous material comprises individual fibers which have a substantially random orientation within the inorganically filled matrix.
60. A sheet as defined in claim 1, wherein the fibrous material comprises individual fibers which have a substantially unidirectional orientation within the inorganically filled matrix.
61. A sheet as defined in claim 1, wherein the sheet may be bent over an angle of up to about 90.degree. without substantial fracture of the inorganically filled matrix.
62. A sheet as defined in claim 1, wherein the sheet may be bent over an angle of up to about 180.degree. without substantial fracture of the inorganically filled matrix.
63. A sheet as defined in claim 1, wherein the sheet will fracture when bent over an angle greater than about 5.degree..
64. A sheet as defined in claim 1, wherein the sheet will fracture when bent over an angle greater than about 45.degree..
65. A sheet as defined in claim 1, wherein the sheet has been fashioned into a desired shape of an article of manufacture.
66. A sheet as defined in claim 1, wherein the sheet has been fashioned into a container.

67. A sheet as defined in claim 1, wherein the sheet comprises a continuous sheet that has been rolled onto a spool.
68. A sheet as defined in claim 1, wherein the fibrous material has a concentration in a range from about 0.5% to about 50% by volume of total solids in the inorganically filled matrix.
69. A sheet comprising an inorganically filled matrix including a substantially homogeneous mixture of organic binder and inorganic aggregate, and fibers substantially homogeneously dispersed throughout the inorganically filled matrix, wherein the inorganically filled matrix has a thickness in a range from about 0.01 mm to about 1 cm, wherein the organic binder is selected from the group consisting of polysaccharide gums, proteins, cellulose-based materials, non-ionic starches, and mixtures thereof, and wherein the inorganic aggregate has a concentration in a range from about 40% to about 95% by weight of total solids in the inorganically filled matrix.
70. A sheet as defined in claim 69, the inorganically filled matrix having a maximum thickness of about 1 mm.
71. A sheet as defined in claim 69, wherein the organic binder, inorganic aggregate, and fibers are initially dispersed in water to form an aqueous inorganically filled mixture, the inorganically filled matrix being formed by removing a substantial portion of the water from the inorganically filled mixture.
72. A sheet as defined in claim 69, wherein the inorganically filled matrix has a thickness of less than about 3 mm.
73. A sheet comprising an inorganically filled matrix including a substantially homogeneous mixture of organic binder and inorganic aggregate, and a fibrous material substantially homogeneously dispersed throughout the inorganically filled matrix, wherein the inorganically filled matrix has a thickness in a range from about 0.01 mm to about 1 cm, degrades after prolonged exposure to water, and is formed by removing a substantial portion of water from an inorganically filled mixture including:
an organic binder being selected from the group consisting of polysaccarides, proteins,

and mixtures or derivatives thereof;
an inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in the inorganically filled mixture;
water; and
a fibrous material.
74. A sheet as defined in claim 73, wherein the inorganically filled matrix has a thickness less than about 1 mm.
75. A sheet as defined in claim 73, wherein the sheet is rolled onto a spool.
76. A sheet as defined in claim 73, wherein the inorganically filled matrix is substantially rigid.
77. A sheet comprising an inorganically filled matrix including a substantially homogeneous mixture of organic binder and inorganic aggregate, and organic fibers substantially homogeneously dispersed throughout the inorganically filled matrix, the organic binder being selected from the group consisting of polysaccarides, proteins, and mixtures or derivatives thereof, wherein the inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in the matrix, and wherein the organic binder and organic fibers have a combined concentration in a range from about 5% to about 60% by weight of total solids in the inorganically filled matrix, and wherein said inorganically filled matrix has a maximum thickness of about 1 cm.
78. A sheet as defined in claim 74, wherein the sheet has a maximum thickness of about 3 mm.
79. A sheet as defined in claim 74, wherein the sheet has a maximum thickness of about 1 mm.
80. A sheet as defined in claim 74, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
81. A sheet as defined in claim 74, wherein the sheet has been fashioned into an article of manufacture.
82. A sheet comprising an inorganically filled matrix including a substantially homogeneous mixture of organic binder and inorganic aggregate, and a fibrous material substantially homogeneously dispersed throughout the inorganically filled matrix, the organic binder being selected from the group consisting of polysaccarides, proteins, and mixtures or derivatives thereof, the inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in the sheet, wherein said inorganically filled matrix is substantially nonporous, and wherein the inorganically filled matrix has a thickness less than about 1 cm.
83. A sheet as defined in claim 82, said sheet having a maximum thickness of about 3 mm.
84. A sheet as defined in claim 82, said sheet having a maximum thickness of about 1 mm.
85. A sheet as defined in claim 82, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures or derivatives thereof.
86. A sheet as defined in claim 82, wherein the sheet has been fashioned into an article of manufacture.
87. A sheet as defined in claim 82, wherein the sheet comprises a continuous sheet that has been rolled onto a spool.

L5: Entry 32 of 46 File: USPT Aug 26, 1997

US-PAT-NO: 5660904
DOCUMENT-IDENTIFIER: US 5660904 A

TITLE: Sheets having a highly inorganically filled organic polymer matrix

DATE-ISSUED: August 26, 1997

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US-CL-CURRENT: 428/36.4; 206/524.3, 206/524.6, 206/524.7, 428/152, 428/182, 428/295.1, 428/295.4, 428/339, 428/43, 428/532, 428/906

CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. A sheet having an inorganically filled matrix prepared by the method comprising the steps of:
mixing together water, a water-dispersible organic polymer binder, an inorganic aggregate material, and optionally fibers to form an inorganically filled moldable mixture in which the individual components are substantially homogeneously dispersed, wherein the inorganic aggregate material has a concentration in a range from about 40% to about 95% by weight of total solids in the moldable mixture and wherein the moldable mixture has a yield stress in a range from about 2 kPa to about 5 MPa;
forming the inorganically filled moldable mixture into an inorganically filled sheet of a predetermined thickness by passing the mixture between at least one pair of reduction rollers without any significant drainage of water in a liquid state from the inorganically filled moldable mixture; and
removing a substantial portion of the water from the inorganically filled sheet by evaporation to form a substantially dried inorganically filled sheet having a thickness up to about 1 cm, the method yielding a sheet in which the inorganically filled matrix is sufficiently flexible such that it can be significantly mechanically deformed without complete rupture of the matrix, wherein the inorganically filled matrix degrades after prolonged exposure to water and comprises a substantially homogeneous mixture of the organic polymer binder and inorganic aggregate material, wherein the fibers are substantially homogeneously dispersed throughout the inorganically filled matrix.
2. A sheet having an inorganically filled matrix as defined in claim 1, wherein the water has a concentration in a range from about 5% to about 50% by volume of the moldable mixture.
3. A sheet having an inorganically filled matrix as defined in claim 1, wherein the mixing step is carried out by means of a kneeder-mixer.
4. A sheet having an inorganically filled matrix as defined in claim 1, wherein the reduction rollers are heated.
5. A sheet having an inorganically filled matrix as defined in claim 1, wherein the forming step includes extruding the moldable mixture through a die.
6. A sheet having an inorganically filled matrix as defined in claim 5, wherein the moldable mixture is extruded into the form of a sheet that is subsequently passed between the reduction rollers.
7. A sheet having an inorganically filled matrix as defined in claim 6, wherein the moldable mixture is extruded using an auger extruder.
8. A sheet having an inorganically filled matrix as defined in claim 6, wherein the moldable mixture is extruded using a piston extruder.
9. A sheet having an inorganically filled matrix as defined in claim 1, wherein the step of removing substantial a portion of the water is carried out by means of a heated drying roller.
10. A sheet having an inorganically filled matrix as defined in claim 1, wherein the step of removing a substantial portion of the water is carried out by means of a drying chamber.

11. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of applying a coating material to a surface of the substantially dried inorganically filled sheet.
12. A sheet having an inorganically filled matrix as defined in claim 11, wherein the coating material increases resistance to water penetration by the sheet.
13. A sheet having an inorganically filled matrix as defined in claim 11, wherein the coating material is selected from the group consisting of melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, edible oils, and mixtures thereof.
14. A sheet having an inorganically filled matrix as defined in claim 11, wherein the coating material is selected from the group consisting of sodium silicate, calcium carbonate, kaolin, silicon oxide, aluminum oxide, ceramic, and mixtures thereof.
15. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of laminating a second sheet to the substantially dried inorganically filled sheet.
16. A sheet having an inorganically filled matrix as defined in claim 15, wherein the second sheet also has an inorganically filled matrix.
17. A sheet having an inorganically filled matrix as defined in claim 15, wherein the second sheet is selected from the group consisting of organic polymer sheets, metal foils, fiber sheets, ceramic sheets, ionomers, elastomeric sheets, plastic sheets, cellophane sheets, nylon sheets, wax sheets, metallized films and combinations of the foregoing.
18. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of corrugating the inorganically filled sheet to yield a corrugated sheet.
19. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of creping the inorganically filled sheet to yield a creped sheet.
20. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of compacting a partially dried inorganically filled sheet.
21. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of calendering the substantially dried inorganically filled sheet.
22. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of applying an indicia onto the sheet.
23. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of score-cutting the substantially dried inorganically filled sheet.
24. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of perforating the substantially dried inorganically filled sheet.
25. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of finishing the substantially dried inorganically filled sheet in order to alter the quality of a surface of the sheet.
26. A sheet having an inorganically filled matrix as defined in claim 25, wherein the finishing step is carried out by passing the sheet between a pair of calendering rollers which impart increased smoothness of the sheet.
27. A sheet having an inorganically filled matrix as defined in claim 25, wherein the finishing step is carried out by passing the sheet between a pair of rollers which impart a textured surface to the sheet.
28. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of rolling the substantially hardened inorganically filled sheet onto a spool in order to form a roll.
29. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of cutting the substantially dried inorganically filled sheet into discontinuous sheets and then stacking the discontinuous sheets in order to form a stack of sheets.
30. A sheet having an inorganically filled matrix as defined in claim 1, further including the step of remoistening the substantially hardened inorganically filled sheet in order to increase flexibility of the sheet.
31. A sheet having an inorganically filled matrix as defined in claim 1, wherein the moldable mixture has a yield stress in a range from about 100 kPa to about 1 MPa.
32. A sheet having an inorganically filled matrix as defined in claim 1, wherein the mixing step is carried out by means of a high shear mixer.
33. A sheet having an inorganically filled matrix as defined in claim 1, wherein the reduction rollers have a temperature in a range from about 50.degree. C. to about 120.degree. C.
34. A sheet having an inorganically filled matrix as defined in claim 1, wherein the reduction rollers have a temperature in a range from about 60.degree. C. to about 85.degree. C.
35. A sheet having an inorganically filled matrix as defined in claim 1, wherein the forming step yields a sheet in which the fibers have a substantially random orientation within the inorganically filled matrix.
36. A sheet having an inorganically filled matrix as defined in claim 1, wherein the forming step yields a sheet in which the fibers have a substantially unidirectional orientation within the inorganically filled matrix.
37. A sheet having an inorganically filled matrix as defined in claim 1, further

including the step of fashioning the substantially dried inorganically filled sheet into a container.
38. A sheet having an inorganically filled matrix as defined in claim 37, wherein the container comprises a food or beverage container.
39. A sheet having an inorganically filled matrix as defined in claim 1, wherein the sheet has a thickness less than about 3 min.
40. A sheet having an inorganically filled matrix as defined in claim 1, wherein the sheet has a thickness less than about 1 mm.
41. A sheet having an inorganically filled matrix as defined in claim 1, wherein the substantially dried inorganically filled sheet has a maximum density of about 1.5 g/cm.sup.3.
42. A sheet having an inorganically filled matrix as defined in claim 1, wherein the substantially dried inorganically filled sheet can be substituted for paper sheets.
43. A sheet having an inorganically filled matrix as defined in claim 1, wherein the sheet can be substituted for paperboard sheets.
44. A sheet having an inorganically filled matrix as defined in claim 1, wherein the sheet has a tensile strength in a range from about 5 MPa to about 60 MPa.
45. A sheet having an inorganically filled matrix as defined in claim 1, wherein the aggregate material has a concentration in a range from about 50% to about 95% by volume of total solids in the moldable mixture.
46. A sheet having an inorganically filled matrix as defined in claim 1, wherein the inorganic aggregate material has a concentration in a range from about 60% to about 80% by volume of total solids in the moldable mixture.
47. A sheet having an inorganically filled matrix as defined in claim 1, wherein the aggregate material comprises individual particles that have been size optimized in order to achieve a predetermined particle packing density of the aggregate material within the inorganically filled moldable mixture.
48. A sheet having an inorganically filled matrix as defined in claim 47, wherein the particle packing density of the aggregate material is at least about 0.65.
49. A sheet having an inorganically filled matrix as defined in claim 1, wherein the aggregate material comprises a lightweight aggregate selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.
50. A sheet having an inorganically filled matrix as defined in claim 1, wherein the aggregate material is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alma, sand, gravel, sandstone, limestone, and mixtures thereof.
51. A sheet having an inorganically filled matrix as defined in claim 1, wherein the inorganically filled matrix further includes an organic aggregate selected from the group consisting of cork, seeds, starches, gelatins, and agar materials.
52. A sheet having an inorganically filled matrix as defined in claim 1, wherein the water-dispersible organic polymer binder has a concentration in a range from about 1% to about 50% by volume of total solids in the moldable mixture.
53. A sheet having an inorganically filled matrix as defined in claim 1, wherein the water-dispersible organic polymer binder has a concentration in a range from about 2% to about 30% by volume of total solids in the moldable mixture.
54. A sheet having an inorganically filled matrix as defined in claim 1, wherein the water-dispersible organic polymer binder has a concentration in a range from about 5% to about 20% by volume of total solids in the moldable mixture.
55. A sheet having an inorganically filled matrix as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a cellulosic material.
56. A sheet having an inorganically filled matrix as defined in claim 55, wherein the cellulosic material is selected from the group consisting of methylhyctroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcelhlose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
57. A sheet having an inorganically filled matrix as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a starch or a derivative thereof.
58. A sheet having an inorganically filled matrix as defined in claim 57, wherein the starch or derivative thereof is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkyl starches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
59. A sheet having an inorganically filled matrix as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a protein or a derivative thereof.
60. A sheet having an inorganically filled matrix as defined in claim 59, wherein the protein or derivative thereof are selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
61. A sheet having an inorganically filled matrix as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a polysaccharide material selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivative thereof.
62. A sheet having an inorganically filled matrix as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a synthetic organic polymer selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl

alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
63. A sheet having an inorganically filled matrix as defined in claim 1, wherein the fibers have a concentration in a range from about 0.5% to about 50% by volume of total solids in the moldable mixture.
64. A sheet having an inorganically filled matrix as defined in claim 1, wherein the fibers have a concentration in a range from about 5% to about 40% by volume of total solids in the moldable mixture.
65. A sheet having an inorganically filled matrix as defined in claim 1, wherein the fibers have a concentration in a range from about 15% to about 30% by volume of total solids in the moldable mixture.
66. A sheet having an inorganically filled matrix as defined in claim 1, wherein the fibers comprise organic fibers.
67. A sheet having an inorganically filled matrix as defined in claim 1, wherein the fibers comprise inorganic fibers.
68. A sheet having an inorganically filled matrix as defined in claim 1, wherein the fibers have an aspect ratio of at least about 10:1.
69. A sheet having an inorganically filled matrix as defined in claim 1, wherein the fibers have an average aspect ratio greater than about 100:1.
70. A sheet having an inorganically filled matrix as defined in claim 1, wherein a portion of the aggregate material includes a hydraulically settable material.
71. A sheet having an inorganically filled matrix prepared by the method comprising the steps of:
mixing together water, a water-dispersible organic polymer binder, an inert inorganic aggregate filler, and fibers to form a moldable inorganically filled mixture in which the individual components are substantially homogeneously dispersed, the inert inorganic aggregate filler having a concentration in a range from about 40% to about 95% by weight of total solids in the inorganically filled mixture, the organic polymer binder and fibers having a combined concentration in a range from about 5% to about 60% by weight of total solids in the mixture, the water having a concentration in a range from about 5% to about 50% by volume of the mixture;
passing the inorganically filled moldable mixture between at least one pair of reduction rollers without any significant drainage of water in a liquid state from the inorganically filled moldable mixture to form a green inorganically filled sheet of a predetermined thickness that maintains its integrity as a sheet substantially free from underlying support as it exits the reduction rollers; and
removing a substantial portion of the water from the inorganically filled sheet in an accelerated manner by evaporation to form the inorganically filled matrix of the sheet, the inorganically filled matrix of the sheet comprising a substantially homogeneous mixture of organic binder and aggregate filler, with the fibers being substantially homogeneously dispersed throughout the inorganically filled matrix, wherein the inorganically filled matrix has a thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water.
72. A sheet having an inorganically filled matrix as defined in claim 71, wherein the inorganically filled matrix has a thickness less than about 3 mm.
73. A sheet having an inorganically filled matrix as defined in claim 71, wherein the inorganically filled matrix has a thickness less than about 1 mm.
74. A sheet having an inorganically filled matrix as defined in claim 71, wherein the inorganically filled matrix has a density in a range from about 0.4 g/cm.sup.3 to about 1.5 g/cm.sup.3.
75. A sheet having an inorganically filled matrix as defined in claim 71, wherein the removing step yields a sheet having a substantially dried inorganically filled matrix in less than 10 minutes.
76. A sheet having an inorganically filled matrix as defined in claim 71, wherein the removing step yields a sheet having a substantially dried inorganically filled matrix in less than 1 minutes.
77. A sheet having an inorganically filled matrix as defined in claim 71, a method further including the step of applying a coating material to the surface of the inorganically filled matrix.
78. A sheet having an inorganically filled matrix as defined in claim 71, further including the step of applying a second sheet to a sheet having an inorganically filled matrix to form a laminated sheet.
79. A sheet having an inorganically filled matrix as defined in claim 71, further including the step of rolling the dried sheet onto a spool to form a spool of the sheet.
80. A spooled sheet having an inorganically filled matrix prepared by the method comprising the steps of:
mixing together water, a water-dispersible organic polymer binder, an inorganic aggregate filler, and organic fibers to form a moldable inorganically filled mixture in which the individual components are substantially homogeneously dispersed, wherein the inorganic aggregate filler has a concentration in a range from about 40% to about 95% by weight of total solids, wherein the organic polymer binder and organic fibers have a combined concentration in a range from about 5% to about 60% by weight of total solids in the inorganically filled mixture, and wherein the water has a concentration in a range from

about 5% to about 50% by volume of the inorganically filled mixture;
forming inorganically filled mixture between at least one pair or reduction rollers without any significant drainage of water in a liquid state from the inorganically filled moldable mixture to form a green inorganically filled sheet that maintains its integrity as a sheet substantially free from underlying support as it exits at least one pair of reduction rollers;
drying the green inorganically filled sheet by removing a substantial portion of the water from the inorganically filled sheet by evaporation to form a substantially dried inorganically filled matrix comprising a substantially homogeneous mixture of the organic polymer binder and inorganic aggregate material, with the fibers being substantially homogeneously dispersed throughout the inorganically filled matrix, wherein the organic polymer binder and organic fibers have a combined concentration in a range from about 5% to about 60% by weight of total solids; and
winding the substantially dried inorganically filled sheet onto a spool to form a spooled sheet.

81. A spooled sheet as defined in claim 80, wherein the inorganically filled matrix degrades after prolonged exposure to water.

82. A spooled sheet as defined in claim 80, wherein the inorganically filled matrix has a maximum thickness of about 3 mm.

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TITLE: Laminated sheets having a highly inorganically filled organic polymer matrix

DATE-ISSUED: September 9, 1997

INVENTOR-INFORMATION:

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CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. A laminated sheet comprising a first sheet having an inorganically filled matrix and a second sheet laminated to a side of the first sheet, the inorganically filled matrix comprising a substantially homogeneous mixture of organic binder and an inorganic aggregate, and a fibrous material dispersed throughout the inorganically filled matrix, the organic binder being selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof, the inorganic aggregate having a concentration in a range from about 40% to about 98% by volume of total solids in the inorganically filled matrix of the first sheet, wherein the inorganically filled matrix has a thickness less than about 1 cm and degrades after prolonged exposure to water.
2. A laminated sheet as defined in claim 1, the second sheet comprising a coating material on a surface of the inorganically filled matrix of the first sheet.
3. A laminated sheet as defined in claim 2, wherein the coating material increases resistance to water penetration through the inorganically filled matrix.
4. A laminated sheet as defined in claim 2, wherein the coating material increases the flexibility of the inorganically filled matrix.
5. A laminated sheet as defined in claim 2, wherein the coating material is safe for use with food or beverages.
6. A laminated sheet as defined in claim 2, wherein the coating material comprises a biodegradable material.
7. A laminated sheet as defined in claim 2, wherein the coating material is selected from the group consisting of melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, edible oils, and mixtures or derivatives thereof.
8. A laminated sheet as defined in claim 2, wherein the coating material is selected from the group consisting of sodium silicate, calcium carbonate, kaolin, silicon oxide, aluminum oxide, ceramic, and mixtures thereof.
9. A laminated sheet as defined in claim 1, wherein the second sheet also includes an inorganically filled matrix.
10. A laminated sheet as defined in claim 1, wherein the second sheet comprises an organic polymer.
11. A laminated sheet as defined in claim 1, wherein the second sheet comprises a metal foil.
12. A laminated sheet as defined in claim 1, wherein the second sheet comprises a fibrous sheet.
13. A laminated sheet as defined in claim 1, wherein the second sheet comprises paper or paperboard.
14. A laminated sheet as defined in claim 1, wherein the second sheet comprises a ceramic sheet.
15. A laminated sheet as defined in claim 1, wherein the second sheet comprises an ionomer.
16. A laminated sheet as defined in claim 1, wherein the second sheet comprises an

elastomeric sheet.
17. A laminated sheet as defined in claim 1, wherein the second sheet comprises a plastic sheet.
18. A laminated sheet as defined in claim 1, wherein the second sheet comprises a cellophane sheet.
19. A laminated sheet as defined in claim 1, wherein the second sheet comprises a nylon sheet.
20. A laminated sheet as defined in claim 1, wherein the second sheet comprises a wax.
21. A laminated sheet as defined in claim 1, wherein the second sheet comprises a metalized film.
22. A laminated sheet as defined in claim 1, further including a third sheet laminated to the first or second sheet.
23. A laminated sheet as defined in claim 22, wherein the third sheet includes an inorganically filled matrix.
24. A laminated sheet as defined in claim 1, wherein the laminated sheet further includes a plurality of sheets laminated to the first and second sheets.
25. A laminated sheet as defined in claim 1, wherein the inorganic aggregate has a concentration in a range from about 50% to about 95% by volume of total solids in the inorganically filled matrix.
26. A laminated sheet as defined in claim 1, wherein the inorganic aggregate has a concentration in a range from about 60% to about 80% by volume of total solids in the inorganically filled matrix.
27. A laminated sheet as defined in claim 1, wherein the inorganic aggregate comprises at least two different aggregate materials.
28. A laminated sheet as defined in claim 1, wherein the inorganic aggregate comprises individual particles that are size optimized in order to achieve a predetermined particle packing density of the aggregate.
29. A laminated sheet as defined in claim 28, wherein the particle packing density of the inorganic aggregate is at least about 0.65.
30. A laminated sheet as defined in claim 28, wherein the particle packing density of the inorganic aggregate is at least about 0.75.
31. A laminated sheet as defined in claim 28, wherein the particle packing density of the inorganic aggregate is at least about 0.85.
32. A laminated sheet as defined in claim 1, wherein the inorganic aggregate comprises a lower density aggregate which reduces the density and increases the insulation ability of the laminated sheet.
33. A laminated sheet having an inorganically filled matrix as defined in claim 32, wherein the lower density aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.
34. A laminated sheet as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
35. A laminated sheet as defined in claim 1, wherein the inorganic aggregate includes an inorganic gel.
36. A laminated sheet as defined in claim 35, wherein the inorganic gel is selected from the group consisting of silica gel, aluminum silicate gel, calcium silicate gel, and mixtures thereof.
37. A laminated sheet as defined in claim 1, wherein the inorganic aggregate includes an inorganic material that is precipitated in situ.
38. A laminated sheet as defined in claim 1, wherein the inorganic aggregate comprises a polymerized silicate.
39. A laminated sheet as defined in claim 1, wherein the inorganically filled matrix further includes an organic aggregate selected from the group consisting of seeds, starch granules, gelatins, agar materials, and mixtures thereof.
40. A laminated sheet having an inorganically filled matrix as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 3 mm.
41. A laminated sheet having an inorganically filled matrix as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 1 mm.
42. A laminated sheet having an inorganically filled matrix as defined in claim 1, wherein the inorganically filled matrix has a thickness in a range from about 0.01 mm to about 0.5 mm.
43. A laminated sheet as defined in claim 1, wherein the organic binder and fibrous material have a combined concentration in a range from about 5% to about 60% by volume of the solids in the inorganically filled matrix.
44. A laminated sheet as defined in claim 1, wherein the organic binder and fibrous material have a combined concentration of less than about 40% by volume of total solids in the inorganically filled matrix of the first sheet.
45. A laminated sheet as defined in claim 1, wherein the organic binder and fibrous material have a combined concentration of less than about 30% by volume of total solids in the inorganically filled matrix of the first sheet.
46. A laminated sheet as defined in claim 1, wherein the organic binder has a concentration in a range from about 1% to about 50% by volume of total solids in the inorganically filled matrix.

47. A laminated sheet as defined in claim 1, wherein the organic binder has a concentration in a range from about 2% to about 30% by volume of total solids in the inorganically filled matrix.
48. A laminated sheet as defined in claim 1, wherein the organic binder has a concentration in a range from about 5% to about 20% by volume of total solids in the inorganically filled matrix.
49. A laminated sheet as defined in claim 1, wherein the organic binder comprises a cellulosic material.
50. A laminated sheet as defined in claim 49, wherein the cellulosic material is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
51. A laminated sheet as defined in claim 1, wherein the organic binder comprises a starch or a derivative thereof.
52. A laminated sheet as defined in claim 51, wherein the starch or derivative thereof is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
53. A laminated sheet as defined in claim 1, wherein the organic binder comprises a protein or derivative thereof selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
54. A laminated sheet as defined in claim 1, wherein the polysaccharide or derivative thereof is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
55. A laminated sheet as defined in claim 1, wherein the inorganically filled matrix further includes a synthetic organic polymer.
56. A laminated sheet as defined in claim 55, wherein the synthetic organic polymer is selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
57. A laminated sheet as defined in claim 1, wherein the fibrous material has a concentration in a range from about 0.5% to about 50% by volume of total solids in the inorganically filled matrix of the first sheet.
58. A laminated sheet as defined in claim 1, wherein the fibrous material has a concentration in a range from about 5% to about 40% by volume of total solids in the inorganically filled matrix of the first sheet.
59. A laminated sheet as defined in claim 1, wherein the fibrous material has a concentration in a range from about 15% to about 30% by volume of total solids in the inorganically filled matrix of the first sheet.
60. A laminated sheet as defined in claim 1, wherein the fibrous material comprises organic fibers.
61. A laminated sheet as defined in claim 60, wherein the organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, and southern hardwood fibers, and mixtures thereof.
62. A laminated sheet as defined in claim 1, wherein the inorganically filled matrix of the first sheet further includes inorganic fibers.
63. A laminated sheet as defined in claim 62, wherein the inorganic fibers are selected from the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.
64. A laminated sheet as defined in claim 1, wherein the fibrous material comprises a mixture of different fibers having varying strengths and flexibilities.
65. A laminated sheet as defined in claim 1, wherein the fibrous material includes individual fibers having an aspect ratio of at least about 10:1.
66. A laminated sheet as defined in claim 1, wherein the fibrous material includes individual fibers having an average aspect ratio of at least about 100:1.
67. A laminated sheet as defined in claim 1, wherein the fibrous material includes individual fibers having an average aspect ratio of at least about 1000:1.
68. A laminated sheet as defined in claim 1, wherein the laminated sheet has a tensile strength in a range from about 0.05 MPa to about 70 MPa.
69. A laminated sheet as defined in claim 1, wherein the laminated sheet has a tensile strength in a range from about 5 MPa to about 40 MPa.
70. A laminated sheet as defined in claim 1, wherein the laminated sheet has a tensile strength to density ratio in a range from about 2 MPa-cm.sup.3 /g to about 200 MPa-cm.sup.3 /g.
71. A laminated sheet as defined in claim 1, wherein the laminated sheet has a tensile strength to density ratio in a range from about 3 MPa-cm.sup.3 /g to about 50 MPa-cm.sup.3 /g.
72. A laminated sheet having as defined in claim 1, wherein the inorganically filled matrix further includes a minor amount of a hydraulically settable material.
73. A laminated sheet as defined in claim 72, wherein the hydraulically settable material comprises a hydraulic cement.
74. A laminated sheet as defined in claim 72, wherein the hydraulically settable material

comprises calcium sulfate hemihydrate.
75. A laminated sheet having an inorganically filled matrix as defined in claim 72, wherein the hydraulically settable material comprises calcium oxide.
76. A laminated sheet as defined in claim 72, wherein the hydraulically settable material has a concentration great enough to impart a binding effect within the inorganically filled matrix.
77. A laminated sheet as defined in claim 1, wherein the inorganically filled matrix has a maximum bulk density of about 2 g/cm.sup.3.
78. A laminated sheet as defined in claim 1, wherein the sheet having an inorganically filled matrix is corrugated.
79. A laminated sheet as defined in claim 1, wherein the sheet having an inorganically filled matrix is creped.
80. A laminated sheet as defined in claim 1, further including an indicia.
81. A laminated sheet as defined in claim 1, further including a score cut.
82. A laminated sheet as defined in claim 1, further including a score.
83. A laminated sheet as defined in claim 1, further including a perforation.
84. A laminated sheet as defined in claim 1, wherein the inorganically filled matrix is formed by removing water by evaporation from an aqueous inorganically filled mixture.
85. A laminated sheet as defined in claim 84, wherein the water has a concentration in a range from about 5% to about 50% by volume of the inorganically filled mixture.
86. A laminated sheet as defined in claim 1, wherein the inorganically filled matrix includes finely dispersed air voids.
87. A laminated sheet as defined in claim 1, wherein the fibrous material comprises individual fibers which have a substantially random orientation within the inorganically filled matrix.
88. A laminated sheet as defined in claim 1, wherein the fibrous material comprises individual fibers which have a substantially unidirectional orientation within the inorganically filled matrix.
89. A laminated sheet as defined in claim 1, wherein the laminated sheet may be bent over an angle of up to about 90.degree. without substantial fracture of the laminated sheet.
90. A laminated sheet as defined in claim 1, wherein the laminated sheet may be bent over an angle of up to about 180.degree. without substantial fracture of the laminated sheet.
91. A laminated sheet as defined in claim 1, wherein the laminated sheet may be rolled around an angular distance of up to about 360.degree. without substantial fracture of the inorganically filled matrix.
92. A laminated sheet as defined in claim 1, wherein the inorganically filled matrix of the first sheet will fracture when bent over an angle greater than about 5.degree..
93. A laminated sheet as defined in claim 1, wherein the inorganically filled matrix of the second sheet will fracture when bent over an angle greater than about 45.degree..
94. A laminated sheet as defined in claim 1, wherein the laminated sheet has been fashioned into a desired shape.
95. A laminated sheet as defined in claim 1, wherein the laminated sheet has been fashioned into a container.
96. A laminated sheet as defined in claim 1, wherein the laminated sheet is rolled onto a spool.
97. A laminated sheet as defined in claim 1, wherein the organic binder, inorganic aggregate, and fibrous material are initially dispersed in water to form an aqueous inorganically filled mixture, the inorganically filled matrix being formed by removing a substantial portion of the water from the inorganically filled mixture.
98. A laminated sheet as defined in claim 1, wherein the second sheet comprises a laminar coating material.
99. A laminated sheet comprising a first sheet having an inorganically filled matrix and a second sheet laminated to the first sheet, wherein the inorganically filled matrix comprises a substantially homogeneous mixture of organic binder and inorganic aggregate, has a thickness less than about 1 cm, degrades after prolonged exposure to water, and is formed by removing a substantial portion of water from an inorganically filled mixture including:
an organic binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof and included in an amount in a range from about 1% to about 50% by volume of total solids in the inorganically filled mixture;
an inorganic aggregate included in an amount in a range from about 40% to about 98% by volume of total solids in the inorganically filled mixture;
water included in an amount such that the inorganically filled mixture has a yield stress in a range from about 2 kPa to about 5 MPa; and
a fibrous material included in an amount in a range from about 0.5% to about 50% by volume of total solids in the inorganically filled mixture.
100. A laminated sheet as defined in claim 99, wherein the inorganically filled matrix has a thickness less than about 3 mm.
101. A laminated sheet as defined in claim 99, wherein the inorganically filled matrix has a thickness less than about 1 mm.
102. A laminated sheet as defined in claim 99, wherein the second sheet is laminated to the first sheet prior to complete hardening of the first sheet.
103. A laminated sheet as defined in claim 99, wherein the second sheet is laminated to the first sheet after the inorganically filled matrix has been substantially hardened.

104. A laminated sheet as defined in claim 99, wherein the laminated sheet is rolled onto a spool.

105. A laminated sheet comprising a first sheet having an inorganically filled matrix and a second sheet laminated to the first sheet, the inorganically filled matrix comprising a substantially homogeneous mixture of organic binder and inorganic aggregate, and organic fibers dispersed throughout the inorganically filled matrix, the organic binder being selected from the group consisting of starch-based materials, cellulose-based materials, polysaccharide gums, proteins, and mixtures or derivatives thereof, wherein the inorganic aggregate has a concentration in a range from about 40% to about 95% by weight of total solids in the inorganically filled matrix, wherein the organic binder and organic fibers have a combined concentration in a range from about 5% to about 60% by weight of total solids in the inorganically filled matrix, and wherein the inorganically filled matrix has a thickness less than about 1 cm.

106. A laminated sheet as defined in claim 105, wherein the second sheet comprises a laminar coating material.

107. A laminated sheet as defined in claim 105, wherein the second sheet comprises a sheet selected from a group consisting of metal foils, fibrous sheets, organic polymer sheets, paper sheets, paperboard sheets, ceramic sheets, isomer sheets, elastomeric sheets, plastic sheets, cellophane sheets, nylon sheets, wax sheets, metalized films, and combinations of the foregoing.

108. A laminated sheet comprising a first sheet having an inorganically filled matrix and a second sheet laminated to a side of the first sheet, the inorganically filled matrix comprising a substantially homogeneous mixture of organic binder and inorganic aggregate material, and optionally a fibrous material dispersed throughout the inorganically filled matrix, the organic binder being selected from the group consisting of starch-based materials, cellulose-based materials, polysaccharide gums, proteins, and mixtures or derivatives thereof, the inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in the inorganically filled matrix of the first sheet, wherein the inorganically filled matrix has a thickness less than about 1 cm, degrades after prolonged exposure to water, and is significantly flexible such that it can be significantly deformed without complete rupture of the inorganically filled matrix.

109. A laminated sheet comprising a first sheet having an inorganically filled matrix and a second sheet laminated to the first sheet, the inorganically filled matrix comprising a substantially homogeneous mixture of organic binder and inorganic aggregate material, and optionally a fibrous material dispersed throughout the inorganically filled matrix, the organic binder being selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof, the inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in the inorganically filled matrix of the first sheet, wherein the inorganically filled matrix has a thickness less than about 1 cm, degrades after prolonged exposure to water, and is significantly flexible such that it can be significantly deformed without complete rupture of the inorganically filled matrix.

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TITLE: Articles having a starch-bound cellular matrix reinforced with uniformly dispersed fibers

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CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix of starch-based binder and inorganic aggregate, the matrix comprising a starch-based binder, an inorganic aggregate filler, and fibers substantially uniformly dispersed throughout the starch-bound cellular matrix, the fibers having an average aspect ratio greater than about 25:1, the inorganic filler having a concentration greater than about 20% by weight of the starch-bound cellular matrix, wherein the starch-bound cellular matrix has a thickness less than about 1 cm, wherein the starch-bound cellular matrix degrades after prolonged exposure to water.
2. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix is formed without a separate conditioning step.
3. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix includes less than about 5% by weight of a synthetic polymer.
4. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix includes less than about 2% by weight of a synthetic polymer.
5. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix includes no synthetic polymer.
6. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a flexural strength greater than about 1 MPa.
7. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a flexural strength greater than about 2 MPa.
8. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a tensile strength greater than about 0.75 MPa.
9. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a tensile strength greater than about 1 MPa.
10. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a fracture energy greater than about 300 J/m.sup.2.
11. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a fracture energy greater than about 600 J/m.sup.2.
12. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a flexural strength normalized with respect to density in a range of about 0.5 MPa/(g/cm.sup.3) to about 60 MPa/(g/cm.sup.3).

13. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a flexural strength normalized with respect to density in a range from about 1 MPa/(g/cm.sup.3) to about 40 MPa/(g/cm.sup.3).

14. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a flexural strength normalized with respect to density in a range from about 2 MPa/(g/cm.sup.3) to about 20 MPa/(g/cm.sup.3).

15. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a tensile strength normalized with respect to density in a range from about 0.5 MPa/(g/cm.sup.3) to about 30 MPa/(g/cm.sup.3).

16. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a tensile strength normalized with respect to density in a range from about 0.75 MPa/(g/cm.sup.3) to about 20 MPa/(g/cm.sup.3).

17. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a tensile strength normalized with respect to density in a range from about 1 MPa/(g/cm.sup.3) to about 12 MPa/(g/cm.sup.3).

18. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a fracture energy normalized with respect to density in a range from about 1000 (J/m.sup.2)/(g/cm.sup.3) to about 10,000 (J/m.sup.2)/(g/cm.sup.3).

19. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a fracture energy normalized with respect to density in a range from about 2000 (J/m.sup.2)/(g/cm.sup.3) to about 7500 (J/m.sup.2)/(g/cm.sup.3).

20. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a fracture energy normalized with respect to density in a range from about 3000 (J/m.sup.2)/(g/cm.sup.3) to about 5000 (J/m.sup.2)/(g/cm.sup.3).

21. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a flexural strength normalized with respect to weight fraction of the starch-based binder in a range from about 5 MPa/(wt. fraction of starch-based binder) to about 100 MPa/(wt. fraction of starch-based binder).

22. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a flexural strength normalized with respect to weight fraction of the starch-based binder in a range from about 10 MPa/(wt. fraction of starch-based binder) to about 75 MPa/(wt. fraction of starch-based binder).

23. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a flexural strength normalized with respect to weight fraction of the starch-based binder in a range from about 20 MPa/(wt. fraction of starch-based binder) to about 60 MPa/(wt. fraction of starch-based binder).

24. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a tensile strength normalized with respect to weight fraction of the starch-based binder in a range from about 3 MPa/(wt. fraction of starch-based binder) to about 50 MPa/(wt. fraction of starch-based binder).

25. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a tensile strength normalized with respect to weight fraction of the starch-based binder in a range from about 4 MPa/(wt. fraction of starch-based binder) to about 30 MPa/(wt. fraction of starch-based binder).

26. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a tensile strength normalized with respect to weight fraction of the starch-based binder in a range from about 5 MPa/(wt. fraction of starch-based binder) to about 20 MPa/(wt. fraction of starch-based binder).

27. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a fracture energy normalized with respect to weight fraction of the starch-based binder in a range from about 2000 (J/m.sup.2)/(wt. fraction of starch-based binder) to about 30,000 (J/m.sup.2)/(wt. fraction of starch-based binder).

28. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a fracture energy normalized with respect to weight fraction of the starch-based binder in a range from about 3000 (J/m.sup.2)/(wt. fraction of starch-based binder) to about 15,000 (J/m.sup.2)/(wt. fraction of starch-based binder).

29. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a fracture energy normalized with respect to weight fraction of the starch-based binder in a range from about 5000 (J/m.sup.2)/(wt. fraction of starch-based binder) to about 10,000 (J/m.sup.2)/(wt. fraction of starch-based binder).

30. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article has a strain before failure in a range from about 1% to about 15%.

31. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article has a strain before failure in a range from about 1% to about 10%.
32. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article has a strain before failure in a range from about 1% to about 5%.
33. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a density in a range from about 0.05 g/cm.sup.3 to about 1 g/cm.sup.3.
34. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a density in a range from about 0.1 g/cm.sup.3 to about 0.5 g/cm.sup.3.
35. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix has a density in a range from about 0.15 g/cm.sup.3 to about 0.25 g/cm.sup.3.
36. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix includes an outer skin portion having a density and an interior foam portion having a density that is significantly lower than the density of the outer skin portion.
37. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 36, wherein the outer skin portion includes virtually no pinholes.
38. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 36, wherein the cross-sectional area of pinholes within the outer skin portion that are large enough to allow passage of moisture is less than about 15% the cross-sectional area of the outer skin portion.
39. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 36, wherein the cross-sectional area of pinholes within the outer skin portion that are large enough to allow passage of moisture is less than about 10% the cross-sectional area of the outer skin portion.
40. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 36, wherein the cross-sectional area of pinholes within the outer skin portion that are large enough to allow passage of moisture is less than about 5% the cross-sectional area of the outer skin portion.
41. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder includes an unmodified starch that has been gelatinized during molding.
42. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder includes a potato starch or potato starch derivative that has been gelatinized during molding.
43. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder includes a waxy corn starch or waxy corn starch derivative that has been gelatinized during molding.
44. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder has an amylose content less than about 45%.
45. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder has an amylose content less than about 35%.
46. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder has an amylose content less than about 25%.
47. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder includes a modified starch.
48. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder includes a starch that has been modified by a process selected from the group consisting of esterification, ethefification, oxidation, acid hydrolysis, cross-linking, and enzyme conversion.
49. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder has a concentration in a range from about 10% to about 80% by weight of the cellular matrix.
50. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder has a concentration in a range from about 30% to about 70% by weight of the cellular matrix.
51. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the starch-based binder has a concentration in a range from about 40% to about 60% by weight of the cellular matrix.
52. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers include naturally occurring organic fibers.
53. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers include cellulosic fibers.
54. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers are derived from at least one fiber source selected from the group consisting of plant leaves, stems, husks, shells, and fruits.
55. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as

defined in claim 1, wherein the fibers are derived from a fiber source selected from the group consisting of hemp, cotton, sisal, abaca, and bagasse.
56. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers are derived from hardwood.
57. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers are derived from softwood.
58. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers include inorganic fibers.
59. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers are derived from a material selected from the group consisting of glass, graphite, silica, ceramic, and metal.
60. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers include recycled paper fibers.
61. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers have a concentration in a range from about 2% to about 80% by weight of the cellular matrix.
62. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers have a concentration in a range from about 4% to about 40% by weight of the cellular matrix.
63. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers have a concentration in a range from about 5% to about 20% by weight of the cellular matrix.
64. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers have an aspect ratio of at least about 100:1.
65. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers have an aspect ratio of at least about 250:1.
66. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers have an average length in a range from about 0.3 mm to about 2 mm.
67. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers have an average length of at least about 2 mm.
68. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers have an average length of at least about 3.5 mm.
69. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the fibers have an average length of at least about 6.5 mm.
70. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the inorganic aggregate filler includes calcium carbonate.
71. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the inorganic aggregate filler is selected from the group consisting of sand, gravel, rock, limestone, sandstone, glass beads, mica, clay, kaolin, synthetic clay, alumina, silica, fly ash, fused silica, tabular alumina, microspheres, calcium sulfate dihydrate, calcium aluminate, hydrated hydraulic cement particles, and unhydrated hydraulic cement particles.
72. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the inorganic aggregate filler is selected from the group consisting of perlite, vermiculite, hollow glass spheres, aerogels, xerogels, porous ceramic spheres, xonotlite, lightweight expanded clays, pumice, and exfoliated rock.
73. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the inorganic aggregate filler has a concentration in a range from about 30% to about 70% by weight of the cellular matrix.
74. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the inorganic aggregate filler has a concentration in a range from about 40% to about 60% by weight of the cellular matrix.
75. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the inorganic aggregate filler has a specific surface area in a range from about 0.1 m.sup.2 /g to about 400 m.sup.2 /g.
76. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the inorganic aggregate filler has a specific surface area in a range from about 0.15 m.sup.2 /g to about 50 m.sup.2 /g.
77. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the inorganic aggregate filler has a specific surface area in a range from about 0.2 m.sup.2 /g to about 2 m.sup.2 /g.
78. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the inorganic aggregate filler has a natural packing density in a range from about 0.5 to about 0.9.
79. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the inorganic aggregate filler has a natural packing density in a range from about 0.6 to about 0.8.
80. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the cellular matrix further comprises a humectant.
81. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, further comprising a coating on a surface of the article.
82. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 81, wherein the coating renders the article more resistant to water.

83. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 81, wherein the coating renders the article more resistant to oils.
84. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 81, wherein the coating comprises a wax.
85. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 81, wherein the coating comprises polyethylene.
86. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 81, wherein the coating comprises polylactic acid.
87. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 81, wherein the coating comprises shellac.
88. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 81, wherein the coating comprises ethyl cellulose.
89. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 81, wherein the coating comprises polyvinyl alcohol.
90. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 81, wherein the coating comprises magnesium stearate.
91. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, the cellular matrix further comprising an integral sealing material.
92. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 91, wherein the internal sealing material comprises polyvinyl alcohol.
93. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article comprises a food or beverage container.
94. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article comprises a liquid tight container.
95. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article is in the shape of a clam shell container.
96. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article is in the shape of a carton.
97. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article is in the shape of a box.
98. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article is in the shape of a cup.
99. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article is in the shape of a plate.
100. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article is in the shape of a bowl.
101. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 1, wherein the article is in the shape of a tray.
102. An article of manufacture having a fiber-reinforced, inorganically filled, starch-bound cellular matrix of starch and inorganic aggregate, the cellular matrix comprising a starch-based binder, an inorganic aggregate filler having a concentration in a range from about 20% to about 80% by weight of the cellular matrix, and fibers substantially uniformly dispersed throughout the matrix, the fibers having an average fiber length in a range from about 2 mm to about 25 mm, an average aspect ratio greater than about 25:1, and a concentration in a range from about 2% to about 80% by volume of the starch-bound cellular matrix, wherein the starch-bound cellular matrix has a thickness less than about 5 mm and degrades after prolonged exposure to water.
103. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 102, wherein the cellular matrix is formed without a separate conditioning step.
104. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 102, wherein the cellular matrix includes less than about 5% by weight of a synthetic polymer.
105. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 102, wherein the cellular matrix includes no synthetic polymer.
106. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 102, wherein the article comprises a food or beverage container.
107. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix comprising a starch-based binder and fibers substantially uniformly dispersed throughout the starch-bound cellular matrix, the fibers having an average length greater than about 2 mm, an average aspect ratio greater than about 25:1, and a concentration in a range from about 2% to about 80% by weight of the cellular matrix, the cellular matrix having a thickness less than about 1 cm and degrades after prolonged exposure to water.
108. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the cellular matrix has a density in a range from about 0.05 g/cm.sup.3 to about 1 g/cm.sup.3.
109. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the cellular matrix has a density in a range from about 0.1 g/cm.sup.3 to about 0.5 g/cm.sup.3.
110. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the cellular matrix includes an outer skin portion having a density and an interior foam portion having a density that is significantly lower than the density of the outer skin portion.
111. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as

defined in claim 107, wherein the starch-based binder includes an unmodified starch that has been gelatinized during molding.
112. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the starch-based binder includes a potato starch or potato starch derivative that has been gelatinized during molding.
113. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the starch-based binder includes a waxy corn starch or waxy corn starch derivative that has been gelatinized during molding.
114. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the starch-based binder includes a modified starch.
115. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the starch-based binder has a concentration in a range from about 10% to about 80% by weight of the cellular matrix.
116. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the starch-based binder has a concentration in a range from about 30% to about 70% by weight of the cellular matrix.
117. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the fibers include naturally occurring organic fibers.
118. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the fibers have an aspect ratio of at least about 100:1.
119. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the fibers have an aspect ratio of at least about 250:1.
120. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the fibers have an average length of at least about 3.5 mm.

121. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, further comprising an inorganic aggregate filler.
122. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 121, wherein the inorganic aggregate filler includes calcium carbonate.
123. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 121, wherein the inorganic aggregate filler is selected from the group consisting of sand, gravel, rock, limestone, sandstone, glass beads, mica, clay, kaolin, synthetic clay, alumina, silica, fly ash, fused silica, tabular alumina, microspheres, calcium sulfate dihydrate, calcium aluminate, hydrated hydraulic cement particles, and unhydrated hydraulic cement particles.
124. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 121, wherein the inorganic aggregate filler is selected from the group consisting of perlite, vermiculite, hollow glass spheres, aerogels, xerogels, porous ceramic spheres, xonotlite, lightweight expanded clays, pumice, and exfoliated rock.
125. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 121, wherein the inorganic aggregate filler has a concentration in a range from about 20% to about 80% by weight of the cellular matrix.
126. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 121, wherein the inorganic aggregate filler has a concentration in a range from about 30% to about 70% by weight of the cellular matrix.
127. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 121, wherein the inorganic aggregate filler has a concentration in a range from about 40% to about 60% by weight of the cellular matrix.
128. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the cellular matrix further comprises a humectant.
129. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, further comprising a coating on a surface of the article.
130. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the article comprises a food or beverage container.
131. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the article comprises a liquid tight container.
132. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the article is in the shape of a clam shell container.
133. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 107, wherein the cellular matrix has a thickness less than about 5 mm.
134. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix comprising a starch-based binder and fibers substantially uniformly dispersed throughout the starch-bound cellular matrix, the fibers having an average length greater than about 2 mm, an average aspect ratio greater than about 25:1, and a concentration in a range from about 2% to about 80% by weight of the cellular matrix, the cellular matrix including an outer skin portion having a density and an interior foam portion having a density that is significantly lower than the density of the outer skin portion.
135. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the cellular matrix has a density in a range from about 0.05 g/cm.sup.3 to about 1 g/cm.sup.3.
136. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the cellular matrix has a density in a range from about 0.1 g/cm.sup.3 to about 0.5 g/cm.sup.3.
137. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as

defined in claim 134, wherein the cellular matrix has a thickness less than about 1 cm.
138. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, further comprising an inorganic aggregate filler.
139. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 138, wherein the inorganic aggregate filler includes calcium carbonate.
140. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 138, wherein the inorganic aggregate filler has a concentration in a range from about 20% to about 80% by weight of the cellular matrix.
141. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 138, wherein the inorganic aggregate filler has a concentration in a range from about 30% to about 70% by weight of the cellular matrix.
142. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, further comprising a coating on a surface of the article.
143. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the starch-based binder includes an unmodified starch that has been gelatinized during molding.
144. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the starch-based binder includes a potato starch or potato starch derivative that has been gelatinized during molding.
145. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the starch-based binder includes a waxy corn starch or waxy corn starch derivative that has been gelatinized during molding.
146. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the starch-based binder includes a modified starch.
147. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the starch-based binder has a concentration in a range from about 10% to about 80% by weight of the cellular matrix.
148. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the starch-based binder has a concentration in a range from about 30% to about 70% by weight of the cellular matrix.
149. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the fibers include naturally occurring organic fibers.
150. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the fibers include inorganic fibers.
151. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the fibers have an aspect ratio of at least about 100:1.
152. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the fibers have an aspect ratio of at least about 250:1.
153. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the fibers have an average length greater than about 3.5 mm.
154. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the cellular matrix further comprises a humectant.
155. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the article comprises a food or beverage container.
156. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the article comprises a liquid-tight container.
157. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 134, wherein the article is in the shape of a clam-shell container.
158. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix of starch and inorganic aggregate, the cellular matrix comprising a starch-based binder, and inorganic aggregate filler, and fibers substantially uniformly dispersed throughout the starch-bound cellular matrix, the fibers having an average aspect ratio greater than about 25:1, the inorganic aggregate filler having a concentration greater than about 20% by weight of the cellular matrix, the cellular matrix including an outer skin portion having a density and an interior foam portion having a density that is significantly lower than the density of the outer skin portion.
159. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the article comprises a food or beverage container.
160. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, further comprising a coating on a surface of the article.
161. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the starch-based binder includes an unmodified starch that has been gelatinized during molding.
162. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the starch-based binder includes a potato starch or potato starch derivative that has been gelatinized during molding.
163. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the starch-based binder includes a waxy cornstarch or waxy cornstarch derivative that has been gelatinized during molding.
164. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the starch-based binder includes a modified starch.
165. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the starch-based binder has a concentration in a range from

about 10% to about 80% by weight of the cellular matrix.
166. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the starch-based binder has a concentration in a range from about 30% to about 70% by weight of the cellular matrix.
167. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the fibers include naturally occurring organic fibers.
168. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the fibers include inorganic fibers.
169. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the fibers have an aspect ratio of at least about 100:1.
170. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the fibers have an aspect ratio of at least about 250:1.
171. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the fibers have an average length greater than about 3.5 min.
172. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein said inorganic aggregate filler is homogeneously dispersed throughout the cellular matrix.
173. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the inorganic aggregate filler includes calcium carbonate.
174. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the inorganic aggregate filler is selected from the group consisting of sand, gravel, rock, limestone, sandstone, glass beads, mica, clay, kaolin, synthetic clay, alumina silica, fly ash, fused silica, tabular alumina, microspheres, calcium sulfate dihydrate, calcium aluminate, hydrated hydraulic cement particles, and unhydrated hydraulic cement particles.
175. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the inorganic aggregate filler is selected from the group consisting of perlite, vermiculite, hollow glass spheres, areogels, xerogels, porous ceramic spheres, xonotlite, lightweight expanded clays, pumice, and exfoliated rock.
176. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the inorganic aggregate filler has a concentration in a range from about 20% to about 80% by weight of the cellular matrix.
177. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the inorganic filler has a concentration in a range from about 30% to about 70% by weight of the cellular matrix.
178. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the inorganic aggregate filler has a concentration in a range from about 40% to about 60% by weight of the cellular matrix.
179. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the cellular matrix further comprises a humectant.
180. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the article comprises a liquid-tight container.
181. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 158, wherein the article is in the shape of a clam-shell container.
182. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix comprising a starch-based binder and fibers substantially uniformly dispersed throughout the starch-bound cellular matrix, the fibers having an average length greater than about 2 mm, an average aspect ratio greater than about 25:1, and a concentration in a range from about 2% to about 80% by weight of the cellular matrix, the cellular matrix having an average density less than about 0.25 g/cm.sup.3.
183. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 182, wherein the article comprises a food or beverage container.
184. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 182, further comprising a coating on a surface of the article.
185. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 182, further comprising an aggregate filler.
186. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 185, wherein the inorganic aggregate filler includes calcium carbonate.
187. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 185, wherein the inorganic aggregate filler is selected from the group consisting of sand, gravel, rock, limestone, sandstone, glass beads, mica, clay, kaolin, synthetic clay, alumina silica, fly ash, fused silica, tabular alumina, microspheres, calcium sulfate dihydrate, calcium aluminate, hydrated hydraulic cement particles, and unhydrated hydraulic cement particles.
188. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 185, wherein the inorganic aggregate filler is selected from the group consisting of perlite, vermiculite, hollow glass spheres, areogels, xerogels, porous ceramic spheres, xonotlite, lightweight expanded clays, pumice, and exfoliated rock.
189. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 185, wherein the inorganic aggregate filler has a concentration in a range from about 20% to about 80% by weight of the cellular matrix.
190. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 185, wherein the inorganic filler has a concentration in a range from

about 30% to about 70% by weight of the cellular matrix.

191. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 185, wherein the inorganic aggregate filler has a concentration in a range from about 40% to about 60% by weight of the cellular matrix.

192. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix comprising a starch-based binder, an aggregate filler, and fibers substantially uniformly dispersed throughout the starch-bound cellular matrix, the fibers having an average length greater than about 2 mm, an average aspect ratio greater than about 25:1, and a concentration in a range from about 2% to about 80% by weight of the cellular matrix, the cellular matrix including an outer skin portion having a density and an interior foam portion having a density that is significantly lower than the density of the outer skin portion.

193. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 192, further comprising a coating on a surface of the article.

194. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 193, wherein the coating comprises a wax.

195. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 193, wherein the coating comprises a polymeric material.

196. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix comprising a starch-based binder, an inorganic aggregate filler, and fibers substantially uniformly dispersed throughout the starch-bound cellular matrix, the fibers having an average length greater than about 2 mm, an average aspect ratio greater than about 25:1, and a concentration in a range from about 2% to about 80% by weight of the cellular matrix, the inorganic aggregate filler having a concentration greater than about 20% by weight of the cellular matrix, the cellular matrix including an outer skin portion having a density and an interior foam portion having a density that is significantly lower than the density of the outer skin portion.

197. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 196, further comprising a coating on a surface of the article.

198. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 197, wherein the coating comprises a wax.

199. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 197, wherein the coating comprises a polymeric material.

200. An article of manufacture having a fiber-reinforced, starch-bound cellular matrix as defined in claim 196, wherein the article comprises a food or beverage container.

L5: Entry 26 of 46 File: USPT Nov 25, 1997

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DOCUMENT-IDENTIFIER: US 5691014 A

TITLE: Coated articles having an inorganically filled organic polymer matrix

DATE-ISSUED: November 25, 1997

INVENTOR-INFORMATION:

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US-CL-CURRENT: 428/34.5; 206/524.3, 206/524.7, 206/819, 428/182, 428/317.9, 428/339, 428/35.8, 428/36.4, 428/36.5, 428/43, 428/532

CLAIMS:

What is claimed and desired to be secured by United States Patent is:
1. An article of manufacture comprising an inorganically filled matrix including a substantially homogenous mixture of organic binder and aggregate, the matrix having a coating on at least a portion thereof such that the matrix is substantially nonporous and having a thickness in a range from about 0.01 mm to about 1 cm, the matrix comprising:
a water-dispersible organic polymer binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof;
an inorganic aggregate having a concentration in a range from about 20% to about 95% by weight of total solids in the inorganically filled matrix; and
fibrous material substantially homogeneously dispersed throughout the inorganically filled matrix.
2. An article of manufacture as defined in claim 1, wherein the coating comprises a material selected from the group consisting of melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, and combinations of the foregoing.
3. An article of manufacture as defined in claim 1, wherein the coating comprises a material selected from the group consisting of sodium silicate, calcium carbonate, kaolin, ceramic, and combinations of the foregoing.
4. An article of manufacture as defined in claim 1, wherein the coating renders the inorganically filled matrix more resistant to water degradation.
5. An article of manufacture as defined in claim 1, wherein the coating material comprises a coating material that is safe for use with food or beverages.
6. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a concentration in a range from about 50% to about 90% by volume of total solids in the inorganically filled matrix.
7. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a concentration in a range from about 60% to about 80% by volume of total solids in the inorganically filled matrix.
8. An article of manufacture as defined in claim 1, wherein the inorganic aggregate comprises individual particles that are size optimized in order to achieve a predetermined particle packing density of the inorganic aggregate.
9. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a particle packing density in a range from about 0.65 to about 0.99.
10. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a particle packing density in a range from about 0.75 to about 0.9.
11. An article of manufacture as defined in claim 1, wherein the inorganic aggregate includes a lightweight aggregate.
12. An article of manufacture as defined in claim 11, wherein the lightweight aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, expanded clay, lightweight expanded geologic materials, pumice, microspheres, and mixtures thereof.
13. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is

selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, metals, sand, gravel, sandstone, limestone, and mixtures thereof.
14. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes an organic aggregate selected from the group consisting of seeds, starches, gelatins, polymers, cork, and agar materials.
15. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes a hydraulically settable material.
16. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 0.5% to about 60% by volume of total solids in the inorganically filled matrix.
17. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 2% to about 40% by volume of total solids in the inorganically filled matrix.
18. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 5% to about 20% by volume of total solids in the inorganically filled matrix.
19. An article of manufacture as defined in claim 1, wherein the fibrous material includes organic fibers.
20. An article of manufacture as defined in claim 19, wherein the organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, and southern hardwood fibers, and mixtures thereof.
21. An article of manufacture as defined in claim 1, wherein the fibrous material comprises inorganic fibers.
22. An article of manufacture as defined in claim 21, wherein the inorganic fibers are selected from the group consisting of glass, silica, ceramic, graphite, and metal fibers, and mixtures thereof.
23. An article of manufacture as defined in claim 1, wherein the fibrous material comprises individual fibers having an average aspect ratio greater than about 10:1.
24. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a cellulose-based polymer.
25. An article of manufacture as defined in claim 24, wherein the cellulose-based polymer is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
26. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a starch-based polymer.
27. An article of manufacture as defined in claim 26, wherein the starch-based polymer is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
28. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a protein-based material.
29. An article of manufacture as defined in claim 28, wherein the protein-based material is selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
30. An article of manufacture as defined in claim 1, wherein the organic polymer binder is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures thereof.
31. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes a synthetic organic polymer selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
32. An article of manufacture as defined in claim 1, wherein the organic polymer binder has a concentration in a range from about 1% to about 60% by volume of total solids in the inorganically filled matrix.
33. An article of manufacture as defined in claim 1, wherein the organic polymer binder has a concentration in a range from about 2% to about 30% by volume of total solids in the inorganically filled matrix.
34. An article of manufacture as defined in claim 1, wherein the organic polymer binder has a concentration in a range from about 5% to about 20% by volume of total solids in the inorganically filled matrix.
35. An article of manufacture as defined in claim 1, wherein the organic polymer binder and fibrous material together have a concentration in a range from about 5% to about 70% by volume of total solids in the inorganically filled matrix.
36. An article of manufacture as defined in claim 1, wherein the organic polymer binder and fibrous material together have a concentration less than about 50% by volume of total solids in the inorganically filled matrix.
37. An article of manufacture as defined in claim 1, wherein the organic polymer binder and fibrous material together have a concentration less than about 30% by volume of total solids in the inorganically filled matrix.
38. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes a discontinuous phase comprising finely dispersed voids.

39. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a thickness in a range from about 0.1 mm to about 1 cm.
40. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a thickness in a range from about 0.5 mm to about 5 mm.
41. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a density in a range from about 0.1 g/cm.sup.3 to about 2 g/cm.sup.3.
42. An article of manufacture as defined in claim 1, wherein the article comprises a container.
43. An article of manufacture as defined in claim 42, wherein the container is in the shape of a box.
44. An article of manufacture as defined in claim 42, wherein the container is in the shape of a hingedly-closable box.
45. An article of manufacture as defined in claim 42, wherein the container is a corrugated box.
46. An article of manufacture as defined in claim 42, wherein the container is in the shape of a tube.
47. An article of manufacture as defined in claim 42, wherein the container is in the shape of a cup.
48. An article of manufacture as defined in claim 42, wherein the container is in the shape of a clam-shell container.
49. An article of manufacture as defined in claim 42, wherein the container is in the shape of a plate.
50. An article of manufacture as defined in claim 42, wherein the container is in the shape of a platter.
51. An article of manufacture as defined in claim 42, wherein the container is in the shape of a bowl.
52. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix includes a score or score cut defining a hinge where the matrix can more easily bend.
53. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix includes a perforation defining a hinge where the matrix can more easily bend.
54. An article of manufacture comprising an inorganically filled matrix including a substantially homogenous mixture of organic binder and inorganic aggregate, wherein the matrix has a coating on at least a portion thereof, degrades after prolonged exposure to water, and has a thickness in a range from about 0.05 mm to about 1 cm, wherein the organic binder is selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof and has a concentration in a range from about 1% to about 60% by volume of total solids in the inorganically filled matrix, wherein the inorganic aggregate has a concentration in a range from about 30% to about 90% by volume of total solids in the inorganically filled matrix, and wherein the inorganically filled matrix further includes a fibrous material substantially homogeneously dispersed therein and having a concentration in a range from about 0.5% to about 60% by volume of total solids in the inorganically filled matrix.
55. An article of manufacture as defined in claim 54, wherein the article is in the shape of a container.
56. An article of manufacture as defined in claim 54, wherein the coating comprises a material selected from the group consisting of melamine, polyvinylchloride, polyvinyl alcohol, polyvinylacetate, polyacrilate, hydroxypropylmethylcellulose, polyethyleneglycol, acrylics, polyurethane, polylactic acid, starch, soybean protein, polyethylene, synthetic polymers, waxes, elastomers, and combinations of the foregoing.
57. An article of manufacture as defined in claim 54, wherein the coating comprises a material selected from the group consisting of sodium silicate, calcium carbonate, kaoline, ceramic and combinations of the foregoing.
58. An article of manufacture as defined in claim 54, wherein the inorganic aggregate has a concentration in a range from about 50% to about 90% by volume of total solids in the inorganically filled matrix.
59. An article of manufacture comprising an inorganically filled matrix including a substantially homogenous mixture of organic binder and aggregate, the matrix having a coating on at least a portion thereof and having a thickness in a range from about 0.01 mm to about 1 cm, the matrix formed by removing a significant quantity of water by evaporation from the inorganically filled mixture comprising:
water;
a water-dispersible organic polymer binder selected from the group consisting of cellulosic materials, nonionic starches, polysaccharide gums, proteins, and mixtures or derivatives thereof;
an inorganic aggregate having a concentration in a range from about 20% to about 95% by weight of total solids in the inorganically filled mixture; and
a fibrous material substantially homogeneously dispersed throughout the inorganically filled mixture.
60. An article of manufacture as defined in claim 59, wherein the inorganically filled matrix is substantially rigid.
61. An article of manufacture as defined in claim 59, wherein the inorganically filled matrix is substantially flexible such that it may be mechanically deformed without complete rupture of the matrix.

62. An article of manufacture as defined in claim 59, wherein the inorganically filled matrix includes a hinged portion.
63. An article of manufacture as defined in claim 62, wherein the hinged portion is directly molded into the inorganically filled matrix.

L5: Entry 25 of 46 File: USPT Dec 30, 1997

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TITLE: Molded articles having an inorganically filled oragnic polymer matrix

DATE-ISSUED: December 30, 1997

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CLAIMS:

What is claimed and desired to be secured by United States Patent is:

1. An article of manufacture comprising an inorganically filled matrix including a substantially homogeneous mixture of organic binder and inorganic aggregate, the organic binder comprising a water-dispersible organic polymer binder selected from the group consisting of polysaccharides, proteins, water-soluble polymers, derivatives of the foregoing, and mixtures of the foregoing, the inorganic aggregate having a concentration in a range from about 20% to about 95% by weight of total solids in the inorganically filled matrix, the inorganically filled matrix including a fibrous material substantially homogeneously dispersed therein, wherein the inorganically filled matrix has a thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water.

2. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a concentration in a range from about 50% to about 90% by volume of total solids in the inorganically filled matrix.

3. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a concentration in a range from about 60% to about 80% by volume of total solids in the inorganically filled matrix.

4. An article of manufacture as defined in claim 1, wherein the inorganic aggregate comprises individual particles that are size optimized in order to achieve a predetermined particle packing density of the inorganic aggregate.

5. An article of manufacture as defined in claim 4, wherein the particle packing density of the inorganic aggregate is in a range from about 0.65 to about 0.99.

6. An article of manufacture as defined in claim 4, wherein the particle packing density of the inorganic aggregate is in a range from about 0.75 to about 0.9.

7. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, expanded clay, lightweight expanded geologic materials, pumice, microspheres, and mixtures thereof.

8. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, metals, sand, gravel, sandstone, limestone, and mixtures thereof.

9. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes an organic aggregate selected from the group consisting of seeds, starches, gelatins, polymers, cork, agar materials, and mixtures of the foregoing.

10. An article of manufacture as defined in claim 1, wherein the inorganic aggregate includes a hydraulically settable material.

11. An article of manufacture as defined in claim 10, wherein the hydraulically settable material comprises a portland cement.

12. An article of manufacture as defined in claim 10, wherein the hydraulically settable material is selected from the group consisting of calcium sulfate hemihydrate and calcium oxide.

13. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 0.5% to about 60% by volume of total solids in the

inorganically filled matrix.
14. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 2% to about 40% by volume of total solids in the inorganically filled matrix.
15. An article of manufacture as defined in claim 1, wherein the fibrous material includes organic fibers selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, southern hardwood fibers, and mixtures thereof.
16. An article of manufacture as defined in claim 1, wherein the fibrous material includes inorganic fibers selected from the group consisting of glass, silica, ceramic, graphite, metal fibers, and mixtures thereof.
17. An article of manufacture as defined in claim 1, wherein the fibrous material includes individual fibers having an average aspect ratio of at least about 10:1.
18. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a cellulosic ether.
19. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a starch or a starch derivative.
20. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a protein or a protein derivative.
21. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a polysaccharide selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures thereof.
22. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a synthetic organic water-soluble polymer selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, derivatives of the foregoing, and mixtures of the foregoing.
23. An article of manufacture as defined in claim 1, wherein the organic binder has a concentration in a range from about 1% to about 60% by volume of total solids in the inorganically filled matrix.
24. An article of manufacture as defined in claim 1, wherein the organic binder has a concentration in a range from about 2% to about 30% by volume of total solids in the inorganically filled matrix.
25. An article of manufacture as defined in claim 1, wherein the organic polymer binder and fibrous material together have a concentration in a range from about 5% to about 70% by volume of total solids in the inorganically filled matrix.
26. An article of manufacture as defined in claim 1, wherein the organic polymer binder and fibrous material together have a concentration less than about 50% by volume of total solids in the inorganically filled matrix.
27. An article of manufacture as defined in claim 1, wherein the organic polymer binder and fibrous material together have a concentration less than about 30% by volume of total solids in the inorganically filled matrix.
28. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes a discontinuous phase comprising finely dispersed voids.
29. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a thickness in a range from about 0.1 mm to about 1 cm.
30. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a thickness in a range from about 0.5 mm to about 5 mm.
31. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes a latex binder.
32. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a density in a range from about 0.2 g/cm.sup.3 to about 1.5 g/cm.sup.3.
33. An article of manufacture as defined in claim 1, wherein the article comprises a container.
34. An article of manufacture as defined in claim 33, wherein the container has a shape selected from the group consisting of a box, a hingedly-closable box, a crate, a tube, a cup, a clam-shell container, an egg carton, a plate, a platter, and a bowl.
35. An article of manufacture as defined in claim 33, wherein the container is in the shape of an article selected from the group consisting of a storing container, dispensing container, portioning container, packaging container, and shipping container.
36. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes a coating material thereon.
37. An article of manufacture as defined in claim 36, wherein the coating material is selected from the group consisting of melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, and combinations of the foregoing.
38. An article of manufacture as defined in claim 36, wherein the coating material is selected from the group consisting of sodium silicate, calcium carbonate, kaolin, ceramic, and combinations of the foregoing.
39. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix includes a score or score cut defining a hinge where the matrix can more easily bend.

40. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix includes a perforation defining a hinge where the matrix can more easily bend.
41. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes a hinge molded therein.
42. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder, inorganic aggregate, and fibrous material are initially dispersed in water to form an inorganically filled mixture from which the article of manufacture is molded.
43. An article of manufacture as defined in claim 42, wherein a substantial quantity of the water is removed from the inorganically filled mixture by evaporation during molding of the article.
44. An article of manufacture comprising an inorganically filled matrix including a substantially homogeneous mixture of organic binder and inorganic aggregate, the organic binder being selected from the group consisting of polysaccharides, proteins, water-soluble polymers, derivatives of the foregoing, and mixtures of the foregoing, the inorganic aggregate having a concentration in a range from about 30% to about 98% by volume of total solids in the inorganically filled matrix, the inorganically filled matrix including a fibrous component substantially homogeneously dispersed therein, wherein the inorganically filled matrix has a thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water.
45. An article of manufacture as defined in claim 44, wherein the organic binder, inorganic aggregate and fibrous component are initially dispersed in water to form an inorganically filled mixture from which the inorganically filled matrix is molded.
46. An article of manufacture as defined in claim 45, wherein a substantial portion of the water is removed by evaporation from the inorganically filled mixture during molding of the inorganically filled matrix therefrom.
47. An article of manufacture as defined in claim 44, wherein the inorganically filled matrix is substantially nonporous.
48. An article of manufacture as defined in claim 44, wherein the inorganically filled matrix includes a discontinuous phase of air voids.
49. An article of manufacture as defined in claim 44, wherein the inorganically filled matrix further includes an organic aggregate selected from the group consisting of seeds, starches, gelatins, polymers, cork, agar, materials and mixtures of the foregoing.
50. An article of manufacture as defined in claim 44, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, metals, sand, gravel, sandstone, limestone, hydrated hydraulic cement particles, and mixtures of the foregoing.
51. An article of manufacture comprising an inorganically filled matrix including a substantially homogeneous mixture of aggregate and organic binder formed by removing a substantial quantity of water by evaporation from an inorganically filled mixture including water, a water-dispersible organic binder selected from the group consisting of polysaccharides, proteins, water-soluble polymers, derivatives of the foregoing, and mixtures of the foregoing, an inorganic aggregate having a concentration in a range from about 20% to about 95% by weight of total solids in the inorganically filled mixture, and a fibrous component substantially homogeneously dispersed throughout the inorganically filled mixture, wherein the inorganically filled matrix has a wall thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water.
52. An article of manufacture as defined in claim 51, wherein the water-dispersible organic binder within the inorganically filled mixture comprises a substantially gelatinized starch or starch derivative.
53. An article of manufacture as defined in claim 51, wherein the inorganically filled mixture further includes substantially ungelatinized starch granules.
54. An article of manufacture as defined in claim 53, wherein the ungelatinized starch granules become substantially gelatinized during formation of the inorganically filled matrix.
55. An article of manufacture as defined in claim 51, wherein the inorganically filled matrix further includes a coating thereon.
56. An article of manufacture as defined in claim 51, wherein the inorganically filled matrix is substantially nonporous.
57. An article of manufacture as defined in claim 51, wherein the inorganically filled matrix further includes a discontinuous phase of air voids.
58. An article of manufacture as defined in claim 51, wherein the inorganically filled matrix is formed by heat molding the inorganically filled mixture into a container.
59. An article of manufacture as defined in claim 58, wherein the container is molded into the shape of an article selected from the group consisting of a box, a hingedly-closable box, a crate, a tube, a cup, a clam-shell container, an egg carton, a platter, a plate, and a bowl.

L5: Entry 22 of 46 File: USPT Jan 6, 1998

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DOCUMENT-IDENTIFIER: US 5705238 A

TITLE: Articles of manufacture fashioned from sheets having a highly inorganically filled organic polymer matrix

DATE-ISSUED: January 6, 1998

INVENTOR-INFORMATION:

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CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. An article of manufacture fashioned from a sheet comprising an inorganically filled matrix including a substantially homogeneous mixture of a water-dispersible organic polymer binder selected from the group consisting of polysaccharides, proteins, water-soluble polymers, and mixtures or derivatives thereof, a fibrous material, and an inorganic aggregate, the inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in the inorganically filled matrix, wherein the inorganically filled matrix of the sheet has a thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water, wherein the fibrous material is substantially homogeneously dispersed throughout the inorganically filled matrix.
2. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a concentration in a range from about 50% to about 95% by volume of total solids in the matrix.
3. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a concentration in a range from about 60% to about 80% by volume of total solids in the matrix.
4. An article of manufacture as defined in claim 1, wherein the aggregate material comprises individual particles that are size optimized in order to achieve a predetermined particle packing density of the aggregate material.
5. An article of manufacture as defined in claim 4, wherein the particle packing density of the aggregate material is at least about 0.65.
6. An article of manufacture as defined in claim 4, wherein the particle packing density of the aggregate material is at least about 0.75.
7. An article of manufacture as defined in claim 4, wherein the particle packing density of the aggregate material is at least about 0.85.
8. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.
9. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
10. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes an organic aggregate selected from the group consisting of seeds, starches, gelatins, and agar materials.
11. An article of manufacture as defined in claim 1, wherein the inorganic aggregate includes an inorganic gel selected from the group consisting of silica gel, aluminum silicate gel, calcium silicate gel, and mixtures thereof.
12. An article of manufacture as defined in claim 1, wherein the inorganic aggregate includes an inorganic material that is precipitated in situ.
13. An article of manufacture as defined in claim 1, wherein the inorganic aggregate comprises a polymerized silicate.

14. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 3 mm.
15. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 1 mm.
16. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a thickness in a range from about 0.1 mm to about 0.5 mm.
17. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder and fibrous component have a combined concentration less than about 40% by volume of total solids in the inorganically filled matrix.
18. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder and fibrous component have a combined concentration less than about 30% by volume of total solids in the inorganically filled matrix.
19. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder has a concentration in a range from about 1% to about 50% by volume of total solids in the inorganically filled matrix.
20. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder has a concentration in a range from about 2% to about 30% by volume of total solids in the inorganically filled matrix.
21. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder has a concentration in a range from about 5% to about 20% by volume of total solids in the inorganically filled matrix.
22. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a cellulosic ether.
23. An article of manufacture as defined in claim 22, wherein the cellulosic ether is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
24. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a starch or starch derivative.
25. An article of manufacture as defined in claim 24, wherein the starch or starch derivative is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
26. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a protein or a protein derivative.
27. An article of manufacture as defined in claim 26, wherein the protein or protein derivative is selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
28. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a polysaccharide material selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
29. An article of manufacture as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a synthetic water-soluble organic polymer.
30. An article of manufacture as defined in claim 29, wherein the synthetic organic water-soluble polymer is selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, derivatives of the foregoing, and mixtures of the foregoing.
31. An article of manufacture as defined in claim 1, wherein the fibrous component has a concentration in a range from about 0.5% to about 50% by volume of total solids in the inorganically filled matrix.
32. An article of manufacture as defined in claim 1, wherein the fibrous component has a concentration in a range from about 5% to about 40% by volume of total solids in the inorganically filled matrix.
33. An article of manufacture as defined in claim 1, wherein the fibrous component has a concentration in a range from about 15% to about 30% by volume of the total solids in the inorganically filled matrix.
34. An article of manufacture as defined in claim 1, wherein the fibrous component includes organic fibers selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, and southern hardwood fibers, and mixtures thereof.
35. An article of manufacture as defined in claim 1, wherein the fibrous component includes inorganic fibers selected from the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.
36. An article of manufacture as defined in claim 1, wherein the fibrous component includes individual fibers having an aspect ratio greater than about 10:1.
37. An article of manufacture as defined in claim 1, wherein the fibrous component includes individual fibers having an average aspect ratio greater than about 100:1.
38. An article of manufacture as defined in claim 1, wherein the aggregate material includes a hydraulically settable material.
39. An article of manufacture as defined in claim 38, wherein the hydraulically settable material is selected from the group consisting of hydraulic cement, calcium sulfate

hemihydrate, calcium oxide, and mixtures thereof.
40. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix includes finely dispersed voids.
41. An article of manufacture as defined in claim 1, wherein the fibrous component includes individual fibers which have a substantially random orientation within the inorganically filled matrix.
42. An article of manufacture as defined in claim 1, wherein the fibrous component comprises individual fibers which have a substantially unidirectional orientation within the inorganically filled matrix.
43. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a tensile strength in a range from about 5 MPa to about 40 MPa.
44. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a tensile strength to density ratio in a range from about 3 MPa.cm.sup.3 /g to about 50 MPa.cm.sup.3 /g.
45. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix can elongate in a range from about 0.5% to about 8% without completely fracturing.

46. An article of manufacture as defined in claim 1, further comprising a coating material on at least a portion of the inorganically filled matrix of the sheet.
47. An article of manufacture as defined in claim 1, wherein the article of manufacture further includes a second sheet laminated to the inorganically filled matrix.
48. An article of manufacture as defined in claim 47, wherein the second sheet is selected from the group consisting of organic polymer sheets, metal foils, fiber sheets, ceramic sheets, ionomers, elastomeric sheets, plastic sheets, cellophane sheets, nylon sheets, wax sheets, metallized films, and combinations of the foregoing.
49. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix is corrugated.
50. An article of manufacture as defined in claim 1, wherein the sheet having an inorganically filled matrix includes a fold line.
51. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix is translucent.
52. An article of manufacture as defined in claim 1, wherein the article of manufacture comprises a container.
53. An article of manufacture as defined in claim 52, wherein the container is a food or beverage container.
54. An article of manufacture as defined in claim 52, wherein the container is a packaging container.
55. An article of manufacture as defined in claim 52, wherein the container is a cup.
56. An article of manufacture as defined in claim 52, wherein the container is a hinged clam-shell container.
57. An article of manufacture as defined in claim 52, wherein the container is a carton.
58. An article of manufacture as defined in claim 52, wherein the container is a box.
59. An article of manufacture as defined in claim 52, wherein the container is a tube.
60. An article of manufacture as defined in claim 52, wherein the container is selected from the group consisting of a can, a frozen juice concentrate container, a potato chip container, an ice cream container, a salt container, a detergent container, a motor oil container, and a mailing tube.
61. An article of manufacture as defined in claim 1, wherein the article of manufacture comprises a platter.
62. An article of manufacture as defined in claim 1, wherein the article of manufacture comprises a lid.
63. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix is formed by removing a substantial portion of water from an inorganically filled mixture including water, the water-dispersible organic binder, the inorganic aggregate, and the fibrous material.
64. An article of manufacture as defined in claim 63, wherein the water is removed by evaporation in an accelerated manner from the inorganically filled mixture.
65. An article of manufacture as defined in claim 63, wherein the water has a concentration less than about 50% by volume of the inorganically filled mixture.
66. An article of manufacture fashioned from an inorganically filled sheet comprising a substantially homogeneous matrix of organic binder and aggregate, with fibers substantially homogeneously dispersed throughout the matrix of organic binder and aggregate, the organic binder being selected from the group consisting of polysaccharides, proteins, water-soluble polymers, and mixtures or derivatives thereof, the aggregate comprising an inorganic aggregate having a concentration in a range of about 40% to about 98% by volume of total solids in the matrix of organic binder and aggregate, the inorganically filled sheet having a thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water.
67. An article of manufacture as defined in claim 66, wherein the article of manufacture is fashioned by bending, folding or rolling the inorganically filled sheet such that the sheet is significantly mechanically deformed without complete rupture of the sheet.
68. An article of manufacture as defined in claim 66, wherein the article of manufacture comprises a container.
69. An article of manufacture as defined in claim 66, wherein the inorganically filled

matrix is formed by removing a substantial portion of water by evaporation from an inorganically filled mixture including water, the water-dispersible organic binder, the inorganic aggregate, and the fibrous material.

70. An article of manufacture fashioned from an inorganically filled sheet comprising a substantially homogeneous matrix of organic binder and aggregate, wherein the matrix has a thickness in a range from about 0.01 mm to about 1 cm, degrades after prolonged exposure to water, and is significantly flexible such that it can be significantly deformed without complete rupture of the matrix, and is fashioned into a desired shape of the article by bending, folding or rolling, the matrix of organic binder and aggregate being formed from an inorganically filled mixture including:

a water-dispersible organic binder selected from the group consisting of polysaccharides, proteins, water-soluble polymers, and mixtures or derivatives thereof;

an inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in the mixture; and

optionally fibers substantially homogeneously dispersed throughout the mixture.

71. An article of manufacture as defined in claim 70, wherein the inorganically filled sheet has a thickness less than about 3 mm.

72. An article of manufacture as defined in claim 70, wherein the article comprises a container.

73. An article of manufacture as defined in claim 70, wherein the water has a concentration less than about 50% by volume of the inorganically filled mixture.

L5: Entry 21 of 46 File: USPT Jan 6, 1998

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TITLE: Molded articles having an inorganically filled organic polymer matrix

DATE-ISSUED: January 6, 1998

INVENTOR-INFORMATION:

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US-CL-CURRENT: 428/34.5; 206/524.1, 206/524.6, 428/152, 428/182, 428/317.9, 428/339, 428/36.4, 428/36.5, 428/43, 428/532 , 428/906

CLAIMS:

What is claimed and desired to be secured by United States Patent is:
1. An article of manufacture having an inorganically filled matrix formed by the process comprising the steps of:
mixing together a water-dispersible organic binder, an inorganic aggregate, water, and a fibrous material together to form a moldable mixture in which the inorganic aggregate has a concentration in a range from about 20% to about 95% by weight of total solids in the moldable mixture and in which the individual components are substantially homogeneously dispersed throughout the inorganically filled mixture;
molding the moldable mixture into a desired shape of the article without any significant drainage of water in a liquid state from the inorganically filled mixture; and
drying the molded mixture in the desired shape of the article in an accelerated manner to form the inorganically filled matrix of the article, the inorganically filled matrix comprising a substantially homogeneous mixture of organic binder and aggregate, wherein the fibrous material is substantially homogeneously dispersed throughout the inorganically filled matrix, wherein the inorganically filled matrix has a thickness in a range from about 0.05 mm to about 1 cm and degrades after prolonged exposure to water.
2. An article of manufacture as defined in claim 1, wherein the mixing step includes combining an air entraining agent into the moldable mixture in order to incorporate a discontinuous phase of finely dispersed air voids.
3. An article of manufacture as defined in claim 2, wherein the mixing step includes combining a stabilizing agent into the moldable mixture for retaining the discontinuous phase of air voids within the moldable mixture.
4. An article of manufacture as defined in claim 1, wherein the mixing step includes:
dispersing the fibrous material into the water using high shear mixing for a period of time sufficient to cause the fibrous material to at least partially disperse throughout the water as individual fibers to form a fibrous slurry;
blending the water-dispersible organic binder into the fibrous slurry using high shear mixing to uniformly disperse the organic binder throughout the slurry to form the moldable mixture and to add shear to the mixture in order to complete the dispersion of fibers throughout the moldable mixture; and
combining a lightweight aggregate with the moldable mixture using low shear mixing.
5. An article of manufacture as defined in claim 1, wherein the process further comprises the steps of:
combining an adsorbing material with the moldable mixture;
exposing a blowing agent to the moldable mixture under pressure such that the blowing agent is adsorbed onto the adsorbing material; and
releasing the pressure on the moldable mixture such that the blowing agent expands, thereby forming voids within the moldable mixture.
6. An article of manufacture as defined in claim 1, wherein the molding and drying steps are carried out using a heated molding apparatus, the molding and drying steps together being completed in a time period less than about 30 seconds.
7. An article of manufacture as defined in claim 1, wherein the molding and drying steps are carried out using a heated molding apparatus, the molding and drying steps together

being completed in a time period less than about 10 seconds.
8. An article of manufacture as defined in claim 1, wherein the moldable mixture is molded into a container.
9. An article of manufacture as defined in claim 8, wherein the container is molded into a shape selected from the group consisting of a box, crate, tube, cup, clam shell container, egg carton, plate, breakfast platter, bowl, and lid.
10. An article of manufacture as defined in claim 1, wherein the molding and drying steps include:
positioning the moldable mixture between a heated male die of a desired shape and a heated female die having a configuration substantially complementary to the shape of the male die, the male die having a top and a base, the base having a circumference;
pressing the moldable mixture between the male die and the female die to mold the mixture into the desired shape of the article; and
removing both the male die and the female die from the molded article when the molded article has achieved form stability so as to be self-supporting independent from the male die and the female die.
11. An article of manufacture as defined in claim 10, wherein the positioning step includes:
inserting the male die partially into the female die in a complementary fashion until a gap is formed between the male die and the female die; and
injecting the mixture into the gap between the male die and the female die.
12. An article of manufacture as defined in claim 10, wherein the positioning step further comprises:
forming the moldable mixture into a mass having a diameter; and
positioning the mass between the male die and the female die before the male die and the female die are pressed together.
13. An article of manufacture as defined in claim 12, wherein the positioning step further comprises:
placing the mass on a template, the template having a passage with an inside perimeter larger than the circumference of the base of the male die, the mass being placed on the template so as to span the passage; and
aligning the passage of the template between the male die and the female die, thereby enabling the male die to travel through the passage of the template when the male die and the female die are pressed together.
14. An article of manufacture as defined in claim 1, wherein the molding and drying steps include:
injecting the moldable mixture into a heated mold having a configuration corresponding to the desired shape of the article, the mixture being injected at a pressure sufficient to fill the heated mold; and
removing the article from the heated mold when the molded article has achieved form stability so as to be self-supporting independent from the mold.
15. An article of manufacture as defined in claim 1, wherein the molding and drying steps include:
injecting the moldable mixture into a parison cavity and about a core rod positioned therein;
positioning the core rod with the mixture positioned thereon into a blow molding mold corresponding to the desired shape of the article of manufacture;
blowing air through the core rod to expand the moldable mixture within the blow molding mold, thereby forming the mixture into the desired shape of the article; and
removing the blow molding mold from the article when the molded article has achieved from stability so as to be self-supporting independent from the blow molding mold.
16. An article of manufacture as defined in claim 1, wherein the molding and drying steps include:
extruding the moldable mixture into the shape of a tube;
capturing the tube between heated extrusion blow molding mold having two halves and walls that define a cavity corresponding to the desired shape of the article;
inserting a blow pin into the tube captured in the mold;
blowing air through the blow pin to expand the mixture against the walls of the heated mold, thereby forming the mixture into the desired shape of the article; and
removing the mold from the article by separating the two halves when the molded article has achieved from stability so as to be self-supporting independent from the mold.
17. An article of manufacture as defined in claim 1, wherein the molding and drying steps include:
positioning the moldable mixture into a heated jiggering mold having walls that define a cavity corresponding to the desired shape of the article;
pressing a rotating roller head against the mixture to mold the mixture against the walls of the mold, thereby molding the mixture into the desired shape of the article;
removing the article from the mold when the molded article has achieved form stability so as to be self-supporting independent from the jiggering mold.
18. An article of manufacture as defined in claim 17, wherein the molding step further includes placing the mold onto a spindle and rotating the mold thereby prior to the pressing step.
19. An article of manufacture as defined in claim 1, wherein the molding step further forming the moldable mixture into a sheet.

20. An article of manufacture as defined in claim 19, wherein the molding step further includes vacuum forming the sheet into the desired shape of the article.
21. An article of manufacture as defined in claim 19, wherein the molding step further includes pressure forming the sheet into the desired shape of the article.
22. An article of manufacture as defined in claim 19, wherein the sheet forming step comprises passing the moldable mixture between a pair of rollers.
23. An article of manufacture as defined in claim 19, wherein the sheet forming step comprises extruding the moldable mixture through a die having a die slit.
24. An article of manufacture as defined in claim 23, wherein the sheet forming step further includes passing the extruded mixture between a pair of reduction rollers.
25. An article of manufacture as defined in claim 19, wherein the sheet forming step further includes passing the sheet between a pair of corrugating rollers to form a corrugated sheet.
26. An article of manufacture as defined in claim 19, wherein the molding step and drying step further include:
pressing the sheet between a heated male die having a desired shape and a heated female die having a complementary shape of the male die in order to form the sheet into the desired shape of the article; and
removing the male die and the female die from the article when the molded article has achieved form stability so as to be self-supporting independent from the male die and the female die.
27. An article of manufacture as defined in claim 19, wherein the sheet forming step includes coating a side of the sheet with a coating material.
28. An article of manufacture as defined in claim 19, wherein the sheet forming step includes perforating or cutting a score into a surface of the molded sheet.
29. An article of manufacture as defined in claim 19, wherein the sheet forming step includes laminating a second sheet to the sheet.
30. An article of manufacture as defined in claim 1, wherein the process further includes applying a coating material to the dried article.
31. An article of manufacture as defined in claim 30, wherein the coating material is selected from the group consisting of melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, and mixtures or derivatives thereof.
32. An article of manufacture as defined in claim 1, wherein the moldable mixture has a ratio of components such that the mixture has a yield stress in a range from about 2 kPa to about 5 MPa.
33. An article of manufacture as defined in claim 1, wherein the moldable mixture has a ratio of components such that the mixture has a yield stress in a range from about 100 kPa to about 1 MPa.
34. An article of manufacture as defined in claim 1, wherein the moldable mixture has a ratio of components such that the mixture has a yield stress in a range from about 200 kPa to about 700 kPa.
35. An article of manufacture as defined in claim 1, wherein at least a portion of the mixing step and at least a portion of the molding step are carried out using a twin auger extruder.
36. An article of manufacture as defined in claim 1, the process further comprising the step of applying a vacuum to the moldable mixture before the molding step in order to remove unwanted air voids from the mixture.
37. An article of manufacture as defined in claim 1, wherein the molding step includes the use of at least one die selected from the group consisting of a split die, progressive die, and a collapsible die.
38. An article of manufacture as defined in claim 1 wherein the molding step is carried out under a pressure in a range from about 25 psi to about 10,000 psi.
39. An article of manufacture as defined in claim 1 wherein the molding step is carried out under a pressure in a range from about 100 psi to about 5,000 psi.
40. An article of manufacture as defined in claim 1, wherein the molding step further includes forming the moldable mixture into a sheet and vacuum forming the sheet into the desired shape of the article, said vacuum forming process is carried out by a process selected from the group consisting of drape forming, straight vacuum forming, drape vacuum forming, snapback vacuum forming, billow/air-slip vacuum forming, billow drape vacuum forming, plug assist vacuum forming, billow/plug-assist/snap back forming, and twin sheet forming.
41. An article of manufacture as defined in claim 1, the process further including the step of fixing print to the dried article.
42. An article of manufacture as defined in claim 1, wherein the article has a thickness less than about 3 mm.
43. An article of manufacture as defined in claim 1, wherein the article has a thickness less than about 1 mm.
44. An article of manufacture as defined in claim 1, wherein the organic binder comprises a cellulosic ether.
45. An article of manufacture as defined in claim 1, wherein the organic binder comprises a starch or a derivative thereof.
46. An article of manufacture as defined in claim 1, wherein the organic binder comprises

a protein or a derivative thereof.
47. An article of manufacture as defined in claim 1, wherein the organic binder is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures derivatives thereof.
48. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a synthetic organic polymer selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
49. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, expanded clay, lightweight expanded geologic materials, pumice, microspheres, and mixtures thereof.
50. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, metals, sand, gravel, sandstone, limestone, and mixtures thereof.
51. An article of manufacture as defined in claim 1, wherein the inorganically filled mixture further includes an organic aggregate selected from the group consisting of seeds, solid starches, gelatins, polymers, cork, agar materials, and mixtures thereof.
52. An article of manufacture having an inorganically filled matrix formed by the process comprising the steps of:
mixing together a water-dispersible organic binder, an inert inorganic aggregate filler, water, and fibers together to form a moldable inorganically filled mixture in which the inorganic aggregate has a concentration in a range from about 20% to about 95% by weight of total solids in the mixture and in which the organic binder, inorganic filler and fibers are substantially randomly dispersed throughout the mixture, the water having a concentration such that the inorganically filled mixture is cohesive and moldable;
molding the inorganically filled mixture into a desired shape of the article of manufacture without any significant drainage of water in a liquid state from the inorganically filled mixture; and
drying the mixture in the desired shape of the article of manufacture in an accelerated manner by applying heat thereto in order to form the inorganically filled matrix of the article, the inorganically filled matrix having a thickness in a range from about 0.05 mm to about 1 cm and comprising a substantially homogeneous mixture of organic binder and aggregate filler with the fibers being substantially homogeneously dispersed throughout the inorganically filled matrix, wherein the inorganically filled matrix is substantially nonporous.
53. An article of manufacture as defined in claim 52, wherein the molding step is carried by means of heated molds, wherein the water is vaporized during the molding step and acts as a blowing agent in order to form a foamed inorganically filled matrix.
54. An article of manufacture as defined in claim 53, wherein the inorganically filled mixture further includes substantially ungelatinized starch granules that become substantially gelatinized during the molding step.
55. An article of manufacture as defined in claim 53, wherein the inorganic aggregate filler comprises calcium carbonate.
56. An article of manufacture as defined in claim 53, wherein the process yields an article in the shape of a container.
57. An article of manufacture as defined in claim 56, wherein the container comprises a cup.
58. An article of manufacture as defined in claim 56, wherein the container comprises a sandwhich container.
59. An article of manufacture as defined in claim 56, wherein the container comprises a plate.
60. An article of manufacture having an inorganically filled matrix formed by the process comprising the steps of:
mixing together a water-dispersable organic binder, an inert inorganic aggregate filler, water, and fibers together to form a moldable inorganically filled mixture in which the inorganic aggregate has a concentration in a range from about 20% to about 95% by weight of total solids in the mixture, in which the fibers and organic binder together have a concentration less than about 70% by weight of total solids in the mixture, and in which the water has a concentration less than about 50% by volume of the moldable mixture, the organic binder, inorganic filler and fibers being substantially randomly dispersed throughout the mixture;
molding the inorganically filled mixture into a desired shape of the article of manufacture without any significant drainage of water in a liquid state from the inorganically filled mixture; and
drying the mixture in the desired shape of the article of manufacture in an accelerated manner by applying heat thereto in order to form the inorganically filled matrix of the article, the inorganically filled matrix having a thickness in a range from about 0.01 mm to about 1 cm and comprising a substantially homogeneous mixture of organic binder and aggregate filler, with the fibers being substantially homogeneously dispersed throughout the inorganically filled matrix, wherein the inorganically filled matrix degrades after prolonged exposure to water.

61. An article of manufacture as defined in claim 60, wherein the molding step is carried by means of heated molds, wherein the water is vaporized during the molding step and acts as a blowing agent in order to form a foamed inorganically filled matrix.

L5: Entry 20 of 46 File: USPT Jan 6, 1998

US-PAT-NO: 5705242
DOCUMENT-IDENTIFIER: US 5705242 A

TITLE: Coated food beverage containers made from inorganic aggregates and polysaccharide, protein, or synthetic organic binders

DATE-ISSUED: January 6, 1998

INVENTOR-INFORMATION:

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US-CL-CURRENT: 428/36.4; 206/524.3, 206/524.6, 206/524.7, 428/317.9, 428/36.5, 428/36.6, 428/36.8, 428/36.92, 428/532

CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. An article of manufacture for storing, dispensing, packaging, or portioning food or beverage products having a structural matrix comprising a substantially homogeneous mixture of aggregate and organic binder reinforced with a fibrous material, the structural matrix formed by removing a substantial quantity of water by evaporation from a hydrated mixture comprising an organic binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof, water, a fibrous material, and an inert inorganic aggregate material, wherein after removing a substantial quantity of the water from the hydrated mixture the inorganic aggregate has a concentration of at least about 40% by weight of the structural matrix, wherein the structural matrix of the article of manufacture is in the shape of a container suitable for use with food or beverage products, has a thickness less than about 1 cm, and has a density less than about 1.5 g/cm.sup.3, wherein at least a portion of the surface of the structural matrix includes a coating thereon and wherein the coating renders the structural matrix substantially nonporous.
2. An article of manufacture for storing, dispensing, packaging, or portioning food or beverage products as defined in claim 1, wherein the coating on at least a portion of the surface of the article prevents leaching of any material into or out of the structural matrix.
3. An article of manufacture for storing, dispensing, packaging, or portioning food or beverage products as defined in claim 1, wherein the coating on at least a portion of the surface of the article renders that portion waterproof.
4. An article of manufacture for storing, dispensing, packaging, or portioning food or beverage products as defined in claim 1, wherein the coating is safe for use with food or beverages.
5. An article of manufacture for storing, dispensing, packaging, or portioning food or beverage products as defined in claim 1, wherein the coating comprises a material selected from the group consisting of prolamine, melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, sodium silicate, calcium carbonate, polyacrylate, and ceramic.
6. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the organic binder comprises a polysaccharide organic binder comprising a cellulosic material, or a derivative thereof.
7. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 6, wherein the cellulosic material is selected from the group consisting of methylhydroxyethylcelllulose, hydroxyethylmethylcellulose, methylcellulose, hydroxyethyllcellulose, carboxymethylcelllulose, ethylcellulose, hydroxyethylpropylcellulose, and mixtures of derivatives thereof.
8. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the organic binder comprises a polysaccharide organic binder comprising a starch-based material or a derivative thereof.

9. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 8, wherein the starch-based material is selected from the group consisting of an amylopectin, amylose, sea-gel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkyl starches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
10. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the organic binder comprises a polysaccharide organic binder selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
11. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the organic binder comprises a protein organic binder selected from the group consisting of prolamine, gelatin, glue, casein, and mixtures or derivatives thereof.
12. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the hydrated mixture further includes a synthetic organic material selected from the group consisting of polyvinyl alcohol, polyvinyl pyrrolidone, polyvinylmethylether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, ethyline oxide polymers, latex and mixtures or derivatives thereof.
13. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the water has a concentration in a range from about 10% to about 80% by volume of the hydrated mixture.
14. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the aggregate material is selected from the group consisting of perlite, vermiculite, exfolliated rock, pumice, lightweight concrete, expanded clay, hollow glass spheres, aerogel, and mixtures thereof.
15. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the structural matrix further includes an elastomeric material which imparts flexibility to the structural matrix.
16. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the aggregate material is selected from the group consisting of calcium carbonate, gypsum, sand, gravel, limestone, sandstone, concrete, clay, ceramic, alumina, and mixtures thereof.
17. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the hydrated mixture further includes an organic aggregate material selected from the group consisting of seeds, cork, starch granules, solid gelatin materials, solid agar materials, and mixtures or derivatives thereof.
18. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the aggregate material has a concentration in a range from about 40% to about 75% by weight of the hydrated mixture.
19. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the aggregate material has a concentration in a range from about 45% to about 65% by weight of the hydrated mixture.
20. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the fibrous material includes individual fibers having an aspect ratio greater than about 10:1.
21. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the fibrous material includes individual fibers having an aspect ratio of at least about 100:1.
22. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the fibrous material has a concentration less than about 20% by volume of the hydrated mixture.
23. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the fibrous material has a concentration in a range from about 0.5% to about 10% by volume of the hydrated mixture.
24. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the fibrous material has a concentration in a range from about 1% to about 6% by volume of the hydrated mixture.
25. An article of manufacture as defined in claim 1, wherein the fibrous material is substantially homogeneously dispersed throughout the structural matrix of aggregate and organic binder.
26. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the article of manufacture comprises a cup.
27. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 26, wherein the cup is manufactured for a single-service use.
28. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the article of manufacture comprises a clam-shell container.
29. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 28, wherein the clam-shell container is

manufactured for a single-service use.
30. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the article of manufacture comprises a box.
31. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the article of manufacture comprises a plate.
32. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 31, wherein the plate is manufactured for a single-service use.
33. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the article of manufacture comprises a bowl.
34. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the organic binder has a concentration in a range from about 0.25% to about 20% by weight of the hydrated mixture.
35. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 1, wherein the structural matrix has a density less than about 1 g/cm.sup.3.
36. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products comprising a structural matrix reinforced with fibers, the structural matrix comprising a substantially homogenous mixture of aggregate and organic binder, the structural matrix formed by removing a substantial quantity of water by evaporation from a hydrated mixture comprising an organic binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof, water, an inert inorganic aggregate material, and fibers, wherein after removing a substantial quantity of the water from the hydrated mixture the inorganic aggregate has a concentration greater than about 40% by weight of the structural matrix, wherein the fibers are substantially homogeneously dispersed throughout the structural matrix of aggregate and organic binder, wherein the structural matrix of the article of manufacture is in the shape of a container suitable for use with food or beverage products, has a density of less than about 1.5 g/cm.sup.3, degrades after prolonged exposure to water, and has a thickness less than about 1 cm, wherein at least a portion of the surface of the structural matrix includes a coating thereon.
37. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 36, wherein the hydrated mixture further includes an organic aggregate material selected from the group consisting of seeds, cork, starch granules, solid gelatin material, solid agar-type materials, and mixtures or derivatives thereof.
38. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 36, wherein the fibers have a concentration up to about 20% by volume of the hydrated mixture.
39. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 36, wherein the structural matrix includes a discontinuous-nonagglomerated phase comprising air voids.
40. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 36, wherein the article of manufacture comprises a cup.
41. An article of manufacture for storing, dispensing, packaging or portioning food or beverage products as defined in claim 36, wherein the article of manufacture comprises a sandwich container.
42. A food or beverage container having a structural matrix comprising a substantially homogeneous mixture of aggregate and organic binder formed by removing a substantial quantity of water by evaporation from a hydrated mixture including water, an organic binder selected from the group consisting of polysaccharides, proteins and mixtures or derivatives thereof, a fibrous material, and an inert inorganic aggregate having a concentration in a range from about 15% to about 70% by weight of the hydrated mixture, wherein the structural matrix of the food or beverage container is suitable for use with food or beverage products, has a density of less than about 1.5 g/cm.sup.3, degrades after prolonged exposure to water, and has a thickness less than about 1 cm, wherein at least a portion of the structural matrix includes a coating.
43. A food or beverage container as defined in claim 42, wherein the hydrated mixture further includes an organic aggregate material selected from the group consisting of seeds, cork, starch granules, solid gelatin material, solid agar materials, and mixtures or derivatives thereof.
44. A food or beverage container as defined in claim 43, wherein the organic aggregate material comprises starch granules in the hydrated mixture, and wherein the starch granules are substantially dispersed throughout the structural matrix of aggregate and organic binder in a substantially gelatinized state.
45. An article of manufacture as defined in claim 42, wherein the structural matrix is substantially porous.
46. An article of manufacture as defined in claim 42, wherein the structural matrix is substantially nonporous.
47. An article of manufacture for storing, dispensing, packaging, or portioning food or

beverage products having a structural matrix comprising a substantially homogeneous mixture of aggregate and organic binder, the structural matrix formed by removing a substantial quantity of water by evaporation from a hydrated mixture comprising an organic binder selected from the group consisting of polysaccharide gums, proteins, cellulose-based materials, nonionic starches, and mixtures or derivatives thereof, water, fibers, and an inert inorganic aggregate material, the inorganic aggregate having a concentration in a range from about 15% to about 70% by weight of the hydrated mixture, wherein the structural matrix of the article of manufacture is in the shape of a container suitable for use with food or beverage products, has a thickness less than about 1 cm and has a density less than about 1.5 g/cm.sup.3, and wherein at least a portion of the surface of the structural matrix includes a coating thereon .

L5: Entry 17 of 46 File: USPT Jan 20, 1998

US-PAT-NO: 5709913
DOCUMENT-IDENTIFIER: US 5709913 A

TITLE: Method and apparatus for manufacturing articles of manufacture from sheets having a highly inorganically filled organic polymer matrix

DATE-ISSUED: January 20, 1998

INVENTOR-INFORMATION:

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CLAIMS:

What is claimed and desired to be secured by U.S. Letters Patent is:
1. An article of manufacture having an inorganically filled matrix formed by the method comprising the steps of:
providing a substantially dried inorganically filled sheet having a substantially flexible inorganically filled matrix, the matrix formed from an inorganically filled mixture comprising water, a water-dispersible organic binder, an inorganic aggregate material, and a fibrous material, wherein the individual components are substantially homogeneously dispersed throughout the inorganically filled mixture, wherein the inorganically filled sheet is formed without any significant drainage of water in a liquid state from the inorganically filled mixture, wherein the inorganic aggregate material has a concentration in a range from about 40% to about 95% by weight of total solids in the inorganically filled matrix, wherein the inorganically filled matrix has a thickness less than about 1 cm, comprises a substantially homogeneous mixture of organic binder and inorganic aggregate material, and degrades after prolonged exposure to water, wherein the fibrous material is substantially homogeneously dispersed throughout the inorganically filled matrix; and
fashioning at least a portion of the inorganically filled sheet into a predetermined shape of the article by bending, folding or rolling such that the sheet is significantly mechanically deformed without complete rupture of the inorganically filled matrix.
2. An article of manufacture as defined in claim 1, wherein the fashioning step comprises folding the sheet into the shape of the article.
3. An article of manufacture as defined in claim 1, wherein the fashioning step comprises convoluting the sheet into the shape of the article.
4. An article of manufacture as defined in claim 1, wherein the fashioning step comprises spiral winding the sheet into the shape of the article.
5. An article of manufacture as defined in claim 1, wherein the fashioning step comprises pressing the sheet into the shape of the article.
6. An article of manufacture as defined in claim 1, wherein the fashioning step further includes assembling at least a portion of the sheet into the shape of the article.
7. An article of manufacture as defined in claim 1, wherein the method yields a food or beverage container.
8. An article of manufacture having an inorganically filled matrix formed by the method comprising the steps of:
mixing together water, a water-dispersible organic binder, an inorganic aggregate material, and a fibrous material to form a moldable inorganically filled mixture in which the individual components are substantially homogeneously dispersed throughout the mixture, wherein the inorganic aggregate material has a concentration in a range from about 40% to about 95% by weight of total solids in the inorganically filled mixture and wherein the mixture has a yield stress in a range from about 2 kPa to about 5 MPa;
forming the inorganically filled mixture into a green inorganically filled sheet of a predetermined thickness by passing the mixture between at least one pair of forming rollers without any significant drainage of water in a liquid state from the

inorganically filled mixture;
removing a substantial portion of the water from the green inorganically filled sheet by evaporation to form a substantially dried sheet having a thickness in a range from about 0.01 mm to about 1 cm, the inorganically filled matrix of the sheet comprising a substantially homogeneous mixture of organic binder and aggregate, with the fibrous material substantially homogeneously dispersed within the inorganically filled matrix, wherein the inorganically filled matrix is substantially nonporous; and
fashioning at least a portion of the substantially dried inorganically filled sheet into a desired shape of the article of manufacture.

9. An article of manufacture as defined in claim 8, wherein the inorganic aggregate material has a concentration in a range from about 50% to about 95% by volume of total solids in the inorganically filled mixture.

10. An article of manufacture as defined in claim 8, wherein the inorganic aggregate material has a concentration in a range from about 60% to about 80% by volume of total solids in the inorganically filled mixture.

11. An article of manufacture as defined in claim 8, wherein the inorganic aggregate material comprises individual particles that are size optimized in order to achieve a predetermined particle packing density of the aggregate.

12. An article of manufacture as defined in claim 8, wherein the particle packing density of the aggregate material is greater than about 0.65.

13. An article of manufacture as defined in claim 8, wherein the particle packing density of the aggregate material is greater than about 0.85.

14. An article of manufacture as defined in claim 8, wherein the aggregate material comprises a lightweight aggregate selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.

15. An article of manufacture as defined in claim 8, wherein the aggregate material is selected from the group consisting of clay, gypsam, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.

16. An article of manufacture as defined in claim 8, wherein the inorganically filled mixture further comprises an organic aggregate selected from the group consisting of seeds, starches, gelatins, agar materials, and mixtures thereof.

17. An article of manufacture as defined in claim 8, wherein the inorganically filled sheet has a thickness less than about 3 mm.

18. An article of manufacture as defined in claim 8, wherein the inorganically filled sheet has a thickness less than about 1 mm.

19. An article of manufacture as defined in claim 8, wherein the organic binder and fibrous material have a combined concentration in a range from about 2% to about 60% by volume of total solids in the inorganically filled mixture.

20. An article of manufacture as defined in claim 8, wherein the organic binder and fibrous material have a combined concentration less than about 30% by volume of total solids in the inorganically filled mixture.

21. An article of manufacture as defined in claim 8, wherein the organic binder has a concentration in a range from about 1% to about 50% by volume of total solids in the inorganically filled mixture.

22. An article of manufacture as defined in claim 8, wherein the organic binder has a concentration in a range from about 5% to about 20% by volume of total solids in the inorganically filled mixture.

23. An article of manufacture as defined in claim 8, wherein the organic binder comprises a cellulosic material.

24. An article of manufacture as defined in claim 23, wherein the cellulosic material is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.

25. An article of manufacture as defined in claim 8, wherein the organic binder comprises a starch or a derivative thereof.

26. An article of manufacture as defined in claim 25, wherein the starch or derivative thereof is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.

27. An article of manufacture as defined in claim 8, wherein the organic binder comprises a protein or a derivative thereof.

28. An article of manufacture as defined in claim 27, wherein the protein or a derivative thereof is selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or a derivative thereof.

29. An article of manufacture as defined in claim 8, wherein the organic binder is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.

30. An article of manufacture as defined in claim 8, wherein the water-dispersable organic polymer binder comprises a synthetic organic polymer selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers,

synthetic clay, latex, and mixtures or derivatives thereof.
31. An article of manufacture as defined in claim 8, wherein the fibrous material has a concentration in a range from about 0.5% to about 50% by volume of total solids in the inorganically filled mixture.
32. An article of manufacture as defined in claim 8, wherein the fibrous material has a concentration in a range from about 15% to about 30% by volume of total solids in the inorganically filled mixture.
33. An article of manufacture as defined in claim 8, wherein the fibrous material comprises organic fibers.
34. An article of manufacture as defined in claim 8, wherein the fibrous material comprises inorganic fibers.
35. An article of manufacture as defined in claim 8, wherein the fibrous material includes individual fibers having an average aspect ratio greater than about 10:1.
36. An article of manufacture as defined in claim 8, wherein the fibrous material includes individual fibers having an average aspect ratio greater than about 100:1.
37. An article of manufacture as defined in claim 8, wherein the inorganically filled matrix has a tensile strength in a range from about 0.05 MPa to about 60 MPa.
38. An article of manufacture as defined in claim 8, wherein a portion of the inorganic aggregate material includes a hydraulically settable material.
39. An article of manufacture as defined in claim 8, wherein the inorganically filled matrix has a maximum density of about 2 g/cm.sup.3.
40. An article of manufacture as defined in claim 8, wherein the inorganically filled matrix has a density in a range from about 0.4 g/cm.sup.3 to about 1.5 g/cm.sup.3.
41. An article of manufacture as defined in claim 8, wherein the water has a concentration in a range from about 5% to about 50% by volume of the inorganically filled mixture.
42. An article of manufacture as defined in claim 8, wherein the fibrous material comprises individual fibers having a substantially random orientation within the inorganically filled matrix.
43. An article of manufacture as defined in claim 8, wherein the fibrous material comprises individual fibers having a substantially unidirectional orientation within the inorganically filled matrix.
44. An article of manufacture as defined in claim 8, wherein the forming step includes extruding the inorganically filled mixture through a die prior to passing the extruded mixture between the forming rollers.
45. An article of manufacture as defined in claim 8, further including the step of compacting a partially dried inorganically filled sheet.
46. An article of manufacture as defined in claim 8, wherein the fashioning step includes fashioning the inorganically filled sheet into a container.
47. An article of manufacture as defined in claim 46, wherein the container comprises a food or beverage container.
48. An article of manufacture as defined in claim 8, further including the step of remoistening the inorganically filled sheet in order to increase its flexibility.
49. An article of manufacture as defined in claim 8, further comprising the step of laminating at least one other sheet to the inorganically filled sheet.
50. An article of manufacture as defined in claim 49, wherein at least the other sheet is also an inorganically filled sheet.
51. An article of manufacture as defined in claim 49, wherein at least the other sheet is selected from the group consisting of organic polymer sheets, metal foil sheets, fiber sheet, ceramic sheets, ionomer sheets, elastomeric sheets, plastic sheets, cellophane sheets, nylon sheets, wax sheets, metallized film sheets, and combinations of the foregoing.
52. An article of manufacture as defined in claim 8, further including the step of corrugating the inorganically filled sheet.
53. An article of manufacture as defined in claim 8, further including the step of coating at least a portion of the inorganically filled sheet with a coating material.
54. An article of manufacture as defined in claim 53, wherein the coating material is selected from the group consisting of edible oils, melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, and mixtures or derivatives thereof.

55. An article of manufacture as defined in claim 8, further comprising the step of scoring the substantially dried inorganically filled sheet prior to fashioning it into the article of manufacture.
56. An article of manufacture as defined in claim 8, further comprising the step of score cutting the substantially dried inorganically filled sheet prior to fashioning it into the article of manufacture.
57. An article of manufacture as defined in claim 8, further comprising the step of perforating the substantially dried inorganically filled sheet prior to fashioning it into the article of manufacture.
58. An article of manufacture as defined in claim 8, further comprising the step of slotting the inorganically filled sheet to aid in forming flaps of a container.
59. An article of manufacture as defined in claim 8, wherein the fashioning step includes

seaming a portion of the inorganically filled sheet.
60. An article of manufacture as defined in claim 8, wherein the fashioning step comprises folding a portion of the sheet into the desired shape of the article.
61. An article of manufacture as defined in claim 8, wherein the article has a shape selected from the group consisting of cartons, boxes, corrugated boxes, sandwich containers, hinged clam-shell containers, dry cereal boxes, milk cartons, fruit juice containers, carriers for beverage containers, ice cream cartons, pleated cups, cone cups, french-fry scoops, fast-food carry-out boxes, wrap-around casing, open ended bags, and envelopes.
62. An article of manufacture as defined in claim 8, wherein the fashioning step comprises the steps of:
cutting a portion of the inorganically filled sheet into a sidewall blank having two straight ends;
convoluting the sidewall blank by overlapping the two straight ends of the sidewall blank to form a sidewall of a cup;
cutting a portion of an inorganically filled sheet into a bottom portion blank;
configuring the bottom portion blank into a bottom portion of a cup; and
assembling the convoluted sidewall and bottom portion together in order to form a two-piece cup.
63. An article of manufacture as defined in claim 62, further comprising the step of seaming together the convoluted sidewall and bottom portion.
64. An article of manufacture as defined in claim 8, wherein the fashioning step comprises convoluting a portion of the inorganically filled sheet into the desired shape of the article of manufacture.
65. An article of manufacture as defined in claim 64, wherein the article is selected from the group consisting of a can, a frozen juice concentrate container, a potato chip container, an ice cream container, a salt container, a detergent container, a motor oil container, a tube, a cone cup, and a mailing tube.
66. An article of manufacture as defined in claim 8, wherein the fashioning step comprises the step of spiral winding at least a portion of the inorganically filled sheet into the desired shape of the article of manufacture.
67. An article of manufacture as defined in claim 66, wherein the article is selected from the group consisting of a cup, a can, a frozen juice concentrate container, a potato chip container, an ice cream container, a salt container, a detergent container, a motor oil container, and a mailing tube.
68. An article of manufacture as defined in claim 8, wherein the fashioning step comprises pressing a portion of the sheet into a predetermined shape of the article.
69. An article of manufacture as defined in claim 68, wherein the fashioning step yields an article selected from the group consisting of a plate, a vending plate, a pie plate, a tray, a baking tray, a bowl, a breakfast platter, a microwaveable dinner tray, a TV dinner tray, an egg carton, a meat packaging platter, a dish, and a lid.
70. An article of manufacture as defined in claim 8, wherein the fashioning step comprises the steps of:
cutting the inorganically filled sheet into a box body blank and a lid blank;
scoring the box body blank and the lid blank to enable folding of the box body blank into a box body and the lid blank into a lid;
folding the box body blank into a box body having corners and the lid blank into a lid having corners; and
staying the corners of the box body and the lid to form a rigid setup box.
71. An article of manufacture as defined in claim 8, wherein the fashioning step comprises forming a pouch from at least a portion of the inorganically filled sheet.
72. An article of manufacture as defined in claim 71, further comprising the step of seaming a portion of the pouch.
73. An article of manufacture having an inorganically filled matrix formed by the method comprising the steps of:
providing a substantially dried inorganically filled sheet wound onto a spool, the sheet having a substantially flexible inorganically filled matrix, the matrix formed from an inorganically filled mixture comprising water, a water-dispersible organic binder, an inorganic aggregate filler having a concentration in a range from about 40% to about 95% by weight of total solids within the inorganically filled mixture, and a fibrous material, wherein the individual components are substantially homogeneously dispersed throughout the inorganically filled mixture, wherein the inorganically filled sheet is formed without any significant drainage of water in a liquid state from the inorganically filled mixture, wherein the inorganically filled matrix comprises a substantially homogeneous mixture of organic binder and aggregate, has a thickness less than about 1 cm, and degrades after prolonged exposure to water;
unwinding a portion of the inorganically filled sheet from the spool; and
fashioning at least a portion of the unwound inorganically filled sheet into a desired shade of the article of manufacture.
74. An article of manufacture as defined in claim 73, wherein the article of manufacture is formed by bending, folding or rolling the inorganically filled sheet.

L5: Entry 14 of 46 File: USPT Apr 7, 1998

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DOCUMENT-IDENTIFIER: US 5736209 A

TITLE: Compositions having a high ungelatinized starch content and sheets molded therefrom

DATE-ISSUED: April 7, 1998

INVENTOR-INFORMATION:

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US-CL-CURRENT: 428/36.4; 428/152, 428/182, 428/317.9, 428/36.5, 428/36.92, 428/43, 428/532, 428/906

CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. A starch-bound sheet comprising:
(a) a binding matrix including starch and a cellulosic ether, the starch having a concentration in a range from about 5% to about 90% by weight of solids in the sheet, the cellulosic ether having a concentration in a range from about 0.5% to about 10% by weight of solids in the sheet;
(b) fibers substantially homogeneously dispersed throughout the binding matrix and having a concentration in a range from about 3% to about 40% by weight of solids in the sheet; and
(c) an inorganic mineral filler included in a range from about 0% to about 90% by weight of solids in the sheet, the starch-bound sheet having a thickness less than about 1 cm and a density greater than about 0.5 g/cm.sup.3.
2. A sheet as defined in claim 1, wherein the starch has a concentration in a range from about 15% to about 75% by weight of total solids in the sheet.
3. A sheet as defined in claim 1, wherein the starch has a concentration in a range from about 30% to about 70% by weight of total solids in the sheet.
4. A sheet as defined in claim 1, wherein the starch comprises unmodified potato starch.
5. A sheet as defined in claim 1, wherein the starch comprises unmodified corn starch.
6. A sheet as defined in claim 1, wherein the starch comprises unmodified waxy corn starch.
7. A sheet as defined in claim 1, wherein the cellulosic ether has a concentration in a range from about 1% to about 5% by weight of total solids in the sheet.
8. A sheet as defined in claim 1, wherein the cellulosic ether has a concentration in a range from about 2% to about 4% by weight of total solids in the sheet.
9. A sheet as defined in claim 1, wherein the cellulosic ether is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
10. A sheet as defined in claim 1, wherein the binding matrix further includes a protein-based binder selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
11. A sheet as defined in claim 1, wherein the binding matrix further includes a polysaccharide selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
12. A sheet as defined in claim 1, wherein the binding matrix further includes a synthetic organic binder selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, latex, and mixtures or

derivatives thereof.
13. A sheet as defined in claim 1, wherein the inorganic mineral filler has a concentration in a range from about 30% to about 70% by weight of total solids in the sheet.
14. A sheet as defined in claim 1, wherein the inorganic mineral filler is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
15. A sheet as defined in claim 1, wherein the inorganic mineral filler comprises individual particles that are size optimized in order to achieve a predetermined natural particle packing density.
16. A sheet as defined in claim 15, wherein the natural particle packing density of the inorganic aggregate is at least about 0.65.
17. A sheet as defined in claim 1, wherein the inorganic mineral filler comprises a lightweight aggregate selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, pumice, and mixtures thereof.
18. A sheet as defined in claim 1, wherein the fibers have a concentration in a range from about 5% to about 30% by weight of total solids in the sheet.
19. A sheet as defined in claim 1, wherein the fibers have a concentration in a range from about 7% to about 20% by weight of total solids in the sheet.
20. A sheet as defined in claim 1, wherein the fibers comprise organic fibers selected from the group consisting of hemp fibers, cotton fibers, bagasse fibers, abaca fibers, flax, southern pine fibers, southern hardwood fibers, and mixtures thereof.
21. A sheet as defined in claim 1, wherein the fibers comprise inorganic fibers selected from the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.
22. A sheet as defined in claim 1, wherein the fibrous material includes individual fibers having an aspect ratio of at least about 10:1.
23. A sheet as defined in claim 1, wherein the fibrous material includes individual fibers having an aspect ratio of at least about 100:1.
24. A sheet as defined in claim 1, wherein said sheet has a thickness less than about 5 mm.
25. A sheet as defined in claim 1, wherein said sheet has a thickness less than about 3 mm.
26. A sheet as defined in claim 1, wherein said sheet has a thickness less than about 1 mm.
27. A sheet as defined in claim 1, wherein the fibers include a mixture of different fibers having varying strengths and flexibilities.
28. A sheet as defined in claim 1, wherein the fibers have a substantially random orientation within the sheet.
29. A sheet as defined in claim 1, wherein the fibers have a substantially unidirectional orientation within the sheet.
30. A sheet as defined in claim 1, wherein the fibers have a substantially bidirectional orientation within the sheet.
31. A sheet as defined in claim 1, wherein the sheet has a tensile strength to density ratio in a range from about 2 MPa.multidot.cm.sup.3 /g to about 500 MPa.multidot.cm.sup.3 /g.
32. A sheet as defined in claim 1, wherein the sheet has a tensile strength to density ratio in a range from about 5 MPa.multidot.cm.sup.3 /g to about 150 MPa.multidot.cm.sup.3 /g.
33. A sheet as defined in claim 1, wherein the sheet has a tensile strength in a range from about 0.05 MPa to about 100 MPa.
34. A sheet as defined in claim 1, wherein the sheet has a tensile strength in a range from about 5 MPa to about 80 MPa.
35. A sheet as defined in claim 1, wherein the sheet has a density greater than about 1 g/cm.sup.3.
36. A sheet as defined in claim 1, wherein the sheet has a density greater than about 1.5 g/cm.sup.3.
37. A sheet as defined in claim 1, wherein the sheet can elongate in a range from about 0.5% to about 12% without completely fracturing.
38. A sheet as defined in claim 1, wherein the sheet is water degradable.
39. A sheet as defined in claim 1, wherein the sheet is corrugated.
40. A sheet as defined in claim 1, wherein the sheet is creped.
41. A sheet as defined in claim 1, wherein the sheet is parchmented.
42. A sheet as defined in claim 1, wherein the sheet further includes a coating.
43. A sheet as defined in claim 1, wherein the sheet further includes a second sheet laminated thereto.
44. A sheet as defined in claim 1, wherein the sheet includes an indicia.
45. A sheet as defined in claim 1, wherein the sheet includes a hinge.
46. A sheet as defined in claim 1, wherein the sheet includes a perforation.
47. A sheet as defined in claim 1, wherein the sheet has been fashioned into a container.

48. A sheet as defined in claim 1, wherein the sheet may be bent over an angle of about 90.degree. without substantially fracturing.
49. A sheet as defined in claim 1, wherein the sheet may be bent over an angle of about

180.degree. without substantially fracturing.
50. A sheet as defined in claim 1, wherein the sheet comprises a continuous sheet that has been rolled onto a spool.
51. An inorganically filled starch-bound sheet comprising:
(a) a binding matrix including starch and a cellulosic ether, the starch having a concentration in a range from about 5% to about 75% weight of solids in the sheet, the cellulosic ether having a concentration in a range from about 0.5% to about 10% by weight of solids in the sheet;
(b) fibers substantially homogeneously dispersed throughout the binding matrix and having a concentration in a range from about 3% to about 40% by weight of solids in the sheet; and
(c) an inorganic mineral filler included in a range from about 20% to about 90% by weight of solids in the sheet, the starch-bound sheet having a thickness less than about 1 cm and a density greater than about 0.5 g/cm.sup.3.
52. An inorganically filled starch-bound sheet as defined in claim 51, wherein the cellulosic ether is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
53. An inorganically filled starch-bound sheet as defined in claim 51, wherein the binding matrix further includes a protein-based binder selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
54. An inorganically filled starch-bound sheet as defined in claim 51, wherein the binding matrix further includes a polysaccharide selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
55. An inorganically filled starch-bound sheet as defined in claim 51, wherein the binding matrix further includes a synthetic organic binder selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, latex, and mixtures or derivatives thereof.
56. An inorganically filled starch-bound sheet as defined in claim 51, wherein the inorganic mineral filler is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
57. An inorganically filled starch-bound sheet as defined in claim 51, wherein the inorganic mineral filler comprises a lightweight aggregate selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, pumice, and mixtures thereof.
58. An inorganically filled starch-bound sheet as defined in claim 51, wherein the fibers comprise organic fibers selected from the group consisting of hemp fibers, cotton fibers, bagasse fibers, abaca fibers, flax, southern pine fibers, southern hardwood fibers, and mixtures thereof.
59. An inorganically filled starch-bound sheet as defined in claim 51, wherein the fibers comprise inorganic fibers selected from the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.
60. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet has a thickness less than about 5 mm.
61. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet has a thickness less than about 3 mm.
62. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet has a thickness less than about 1 mm.
63. An inorganically filled starch-bound sheet as defined in claim 51, wherein the fibers have a substantially random orientation within the sheets.
64. An inorganically filled starch-bound sheet as defined in claim 51, wherein the fibers have a substantially unidirectional orientation within the sheet.
65. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet has a density greater than about 1 g/cm.sup.3.
66. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet has a density greater than about 1.5 g/cm.sup.3.
67. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet is water degradable.
68. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet further includes a coating on at least a portion thereof.
69. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet further includes a second sheet laminated thereto.
70. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet includes a hinge.
71. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet is fashioned into a container.
72. An inorganically filled starch-bound sheet as defined in claim 51, wherein the sheet comprises a continuous sheet that has been rolled onto a spool.
73. A starch-bound sheet formed by passing a starch-based composition between at least one set of heated rollers, the starch-bound sheet having a thickness less than about 1 cm

and a density greater than about 0.5 g/cm.sup.3, the starch-based mixture comprising:
(a) water;
(b) ungelatinized starch granules having a concentration in a range from about 5% to about 90% by weight of total solids in the starch-based composition;
(c) a cellulosic ether having a concentration in a range from about 0.5% to about 10% by weight of total solids in the starch-based composition;
(d) an inorganic mineral filler having a concentration in a range from about 0% to about 90% by weight of solids in the starch-based composition; and
(e) fibers having a concentration in a range from about 3% to about 40% by weight of total solids in the starch-based composition.
74. A starch-bound sheet as defined in claim 73, wherein at least a portion of the ungelatinized starch granules in the starch-based composition become at least partially gelatinized upon formation of the starch-bound sheet.
75. A starch-bound sheet as defined in claim 73, wherein the cellulosic ether reduces adhesion between the starch-based composition and the heated rollers during formation of the starch-bound sheet.
76. A starch-bound sheet as defined in claim 73, wherein the sheet has the thickness of less than about 3 mm.
77. A starch-bound sheet as defined in claim 73, wherein the sheet has the thickness of less than about 1 mm.
78. A starch-bound sheet as defined in claim 73, wherein the sheet has a density greater than about 1 g/cm.sup.3.
79. A starch-bound sheet as defined in claim 73, wherein the sheet has a density greater than about 1.5 g/cm.sup.3.
80. A starch-bound sheet as defined in claim 73, wherein the sheet further includes a coating on at least a portion thereof.
81. A starch-bound sheet as defined in claim 73, wherein the sheet is fashioned into a container.
82. A starch-bound sheet as defined in claim 73, wherein the sheet comprises a continuous sheet that has been rolled onto a spool.
83. A starch-bound sheet as defined in claim 73, wherein the sheet further includes at least one other sheet laminated thereto.
84. A starch-bound sheet as defined in claim 83, wherein the at least one other sheet is selected from the group consisting of starch-bound sheets, organic polymer sheets, metal foil sheets, ionomer sheets, elastomeric sheets, plastic sheets, fibrous sheets, mats, paper sheets, cellophane sheets, nylon sheets, wax sheets, hydraulically settable sheets, highly inorganically filled sheets, metallized film sheets and combinations thereof.
85. (New) A starch-bound sheet as defined in claim 73, wherein the starch-based composition further includes a hydraulically settable binder.
86. An inorganically filled starch-bound sheet formed by passing a starch-based composition between at least one set of heated rollers, the starch-bound sheet having a thickness less than about 1 cm and a density greater than about 0.5 g/cm.sup.3, the starch-based mixture comprising:
(a) water;
(b) ungelatinized starch granules having a concentration in a range from about 5% to about 75% by weight of total solids in the starch-based composition;
(c) a cellulosic ether having a concentration in a range from about 0.5% to about 10% by weight of total solids in the starch-based composition;
(d) an inorganic mineral filler having a concentration in a range from about 20% to about 90% by weight of solids in the starch-based composition; and
(e) fibers having a concentration in a range from about 3% to about 40% by weight of total solids in the starch-based composition.

L5: Entry 13 of 46 File: USPT Apr 14, 1998

US-PAT-NO: 5738921
DOCUMENT-IDENTIFIER: US 5738921 A

TITLE: Compositions and methods for manufacturing sealable, liquid-tight containers comprising an inorganically filled matrix

DATE-ISSUED: April 14, 1998

INVENTOR-INFORMATION:

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US-CL-CURRENT: 428/36.4; 206/524.3, 206/524.7, 206/819, 428/317.9, 428/34.5, 428/36.1, 428/36.5, 428/36.92, 428/532, 428/906

CLAIMS:

What is claimed and desired to be secured by United States Patent is:
1. An article of manufacture comprising a sealable container having a liquid-tight barrier, at least a substantial portion of the sealable container comprising an inorganically filled matrix molded from an inorganically filled mixture, the inorganically filled mixture including:
water;
an organic polymer binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof;
an inorganic aggregate filler having a concentration in a range from about 20% to about 90% by weight of solids within the mixture; and
a fibrous material,
wherein the fibrous material is substantially homogeneously dispersed throughout the inorganically filled matrix, wherein the inorganically filled matrix includes organic components in an amount of at least about 5% by weight of solids within the inorganically filled matrix, and wherein the inorganically filled matrix has a thickness less than about 1 cm.
2. An article of manufacture as defined in claim 1, wherein the water is included in an amount in a range from about 5% to about 80% by weight of the inorganically filled mixture.
3. An article of manufacture as defined in claim 1, wherein the water is included in an amount in a range from about 10% to about 70% by weight of the inorganically filled mixture.
4. An article of manufacture as defined in claim 1, wherein the water is included in an amount in a range from about 20% to about 50% by weight of the inorganically filled mixture.
5. An article of manufacture as defined in claim 1, wherein the organic polymer binder is included in an amount in a range from about 1% to about 60% by weight of solids in the inorganically filled mixture.
6. An article of manufacture as defined in claim 1, wherein the organic polymer binder is included in an amount in a range from about 2% to about 30% by weight of solids in the inorganically filled mixture.
7. An article of manufacture as defined in claim 1, wherein the organic polymer binder is included in an amount in a range from about 5% to about 20% by weight of solids in the inorganically filled mixture.
8. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a cellulosic material selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
9. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a starch-based material selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain

alkylstarches, dextrines, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
10. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a protein-based material selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
11. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a polysaccharide selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
12. An article of manufacture as defined in claim 1, wherein the inorganically filled mixture further includes a synthetic organic polymer.
13. An article of manufacture as defined in claim 12, wherein the synthetic organic polymer is selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
14. An article of manufacture as defined in claim 1, wherein the inorganic aggregate filler is included in an amount in a range from about 20% to about 80% by weight of solids in the inorganically filled mixture.
15. An article of manufacture as defined in claim 1, wherein the inorganic aggregate filler is included in an amount in a range from about 30% to about 70% by weight of solids in the inorganically filled mixture.
16. An article of manufacture as defined in claim 1, wherein the inorganic aggregate filler comprises individual particles that are size optimized in order to achieve a predetermined particle packing density of the inorganic aggregate filler.
17. An article of manufacture as defined in claim 1, wherein the inorganic aggregate filler comprises a lightweight aggregate which reduces the density and increases the insulation ability of the inorganically filled matrix.
18. An article of manufacture as defined in claim 17, wherein the lightweight aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, xonotlite, aerogels, xerogels, tabular alumina, expanded clay, lightweight expanded geologic materials, pumice, microspheres, and mixtures thereof.
19. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, fused silica, alumina, metals, sand, gravel, sandstone, limestone, hydrated cement particles, calcium aluminate, glass beads, and mixtures thereof.
20. An article of manufacture as defined in claim 1, wherein the inorganically filled mixture further includes an organic aggregate selected from the group consisting of seeds, starches, gelatins, polymers, cork, agar materials, plastic spheres, and mixtures or derivatives thereof.
21. An article of manufacture as defined in claim 1, wherein the inorganically filled mixture further includes a hydraulically settable material.
22. An article of manufacture as defined in claim 1, wherein the fibrous material is included in an amount in a range from about 0.5% to about 60% by weight of solids in the inorganically filled mixture.
23. An article of manufacture as defined in claim 1, wherein the fibrous material is included in an amount in a range from about 2% to about 40% by weight of solids in the inorganically filled mixture.
24. An article of manufacture as defined in claim 1, wherein the fibrous material is included in an amount in a range from about 5% to about 20% by weight of solids in the inorganically filled mixture.
25. An article of manufacture as defined in claim 1, wherein the fibrous material comprises natural organic fibers.
26. An article of manufacture as defined in claim 25, wherein the natural organic fibers are selected from the group consisting of hemp fibers, sisal fibers, cotton fibers, bagasse fibers, abaca fibers, flax fibers, southern pine fibers, southern hardwood fibers, and mixtures thereof.
27. An article of manufacture as defined in claim 1, wherein the fibrous material comprises inorganic fibers.
28. An article of manufacture as defined in claim 27, wherein the inorganic fibers are selected from the group consisting of glass fibers, silica fibers, ceramic fibers, graphite fibers, metal fibers, and mixtures thereof.
29. An article of manufacture as defined in claim 1, wherein the fibrous material comprises synthetic organic fibers.
30. An article of manufacture as defined in claim 29, wherein the synthetic organic fibers are selected from the group consisting of plastic fibers, polyaramide fibers, polylactic acid fibers, polyethylene fibers, polypropylene fibers, and mixtures thereof.
31. An article of manufacture as defined in claim 1, wherein the fibrous material comprises individual fibers having an aspect ratio greater than about 10:1.
32. An article of manufacture as defined in claim 1, wherein the fibrous material comprises individual fibers having an aspect ratio greater than about 100:1.
33. An article of manufacture as defined in claim 1, wherein the fibrous material includes continuous fibers.

34. An article of manufacture as defined in claim 33, wherein the continuous fibers are wrapped around the inorganically filled matrix of the sealable container.
35. An article of manufacture as defined in claim 33, wherein the continuous fibers are embedded within the inorganically filled matrix of the sealable container.
36. An article of manufacture as defined in claim 33, wherein the continuous fibers are spiral wound.
37. An article of manufacture as defined in claim 1, wherein the fibrous material is selected from the group consisting of a fibrous mesh, mat, and fabric.
38. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 5 mm.
39. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 3 mm.
40. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 1 mm.
41. An article of manufacture as defined in claim 1, wherein the liquid-tight barrier is pressure-tight, wherein the sealable container has an interior and an exterior, and wherein the inorganically filled matrix can withstand a differential in pressure between the interior and the exterior of the sealable container of up to about 10 MPa of pressure.
42. An article of manufacture as defined in claim 1, further including a coating on at least a portion of a surface of the inorganically filled matrix of the sealable container.
43. An article of manufacture as defined in claim 42, wherein the coating renders the portion of the inorganically filled matrix impermeable to gases.
44. An article of manufacture as defined in claim 42, wherein the coating renders the portion of the inorganically filled matrix impermeable to liquids.
45. An article of manufacture as defined in claim 42, wherein the coating strengthens the portion of the inorganically filled matrix.
46. An article of manufacture as defined in claim 42, wherein the coating is selected from the group consisting of sodium silicate, orthosilicates, siloxanes, colloidal silica in organic polymer dispersions, colloidal silica in films, colloidal silica in fibers, calcium carbonate, kaolin clay, ceramics, and mixtures thereof.
47. An article of manufacture as defined in claim 42, wherein the coating is selected from the group consisting of biodegradable plastics, acrylics, polyacrylates, polyurethanes, melamines, polyethylene, synthetic polymers, hydroxypropylmethylcellulose, ethylcellulose, polyethylene glycol, prolamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polylactic acid, waxes, and mixtures thereof.
48. An article of manufacture as defined in claim 1, further including a liner on at least a portion of a surface of the inorganically filled matrix of the sealable container.
49. An article of manufacture as defined in claim 48, wherein the liner comprises blow-molded glass.
50. An article of manufacture as defined in claim 1, further including a laminated material on at least a portion of a surface of the inorganically filled matrix of the sealable container.
51. An article of manufacture as defined in claim 1, wherein the sealable container comprises a can.
52. An article of manufacture as defined in claim 1, wherein the sealable container comprises a carton.
53. An article of manufacture as defined in claim 1, wherein the sealable container comprises a box.
54. An article of manufacture as defined in claim 1, wherein the sealable container comprises a bottle.
55. An article of manufacture as defined in claim 1, wherein the sealable container comprises a jar.
56. An article of manufacture as defined in claim 1, wherein the sealable container comprises a pouch.
57. An article of manufacture as defined in claim 1, wherein the sealable container has a circular cross-section.
58. An article of manufacture as defined in claim 1, wherein the sealable container has a rectangular cross-section.
59. An article of manufacture as defined in claim 1, wherein the sealable container has a square-shaped cross-section.
60. An article of manufacture as defined in claim 1, wherein the sealable container has an oval-shaped cross-section.
61. An article of manufacture as defined in claim 1, wherein at least a portion of the inorganically filled matrix of the sealable container is hinged.
62. An article of manufacture as defined in claim 1, wherein the sealable container has structural components comprising:
a hollow body portion having side walls connected to a bottom portion and an open end; and
a closure means for engaging the open end of the hollow body portion to seal substances within the sealable container.
63. An article of manufacture as defined in claim 1, wherein the sealable container has

structural components comprising:
a hollow body portion having side walls connected to a bottom portion and an open end; and
a closure means for engaging the open end of the hollow body portion to seal substances within the sealable container, for dispensing substances, and for resealing substances within the sealable container.
64. An article of manufacture as defined in claim 1, wherein the sealable container has structural components comprising:
a hollow body portion having side walls connected to a bottom portion and an open end; and
a closure means for engaging the open end of the hollow body portion to seal substances within the sealable container and for dispensing substances.
65. An article of manufacture as defined in claim 64, wherein the bottom portion of the hollow body portion comprises a material selected from the group consisting of metals, glass, plastics, and paper composites.
66. An article of manufacture as defined in claim 64, wherein the side walls of the hollow body portion comprise a material selected from the group consisting of metals, glass, plastics, and paper composites.
67. An article of manufacture as defined in claim 64, wherein the closure means comprises a material selected from the group consisting of metals, glass, plastics, and paper composites.
68. An article of manufacture as defined in claim 64, wherein the bottom portion of the hollow body portion and the side walls of the hollow body portion are integrally formed together.
69. An article of manufacture as defined in claim 64, wherein the closure means comprises a lid.
70. An article of manufacture as defined in claim 64, wherein the closure means comprises a foil covering.
71. An article of manufacture as defined in claim 64, wherein the closure means comprises:
a top having a conical portion and a nozzle portion; and
a cap.
72. An article of manufacture as defined in claim 71, wherein the cap has internal threads and the nozzle portion of the top has complementary external threads configured to engage the internal threads of the cap to create a seal.
73. An article of manufacture as defined in claim 71, wherein the cap is a crimped bottle cap.
74. An article of manufacture as defined in claim 64, wherein the closure means comprises a flat cover and a pulltab.
75. An article of manufacture as defined in claim 64, wherein the closure means comprises a top and a spray mechanism.
76. An article of manufacture comprising a sealable container having a liquid-tight barrier, at least a substantial portion of the sealable container comprising a sheet having an inorganically filled matrix, the matrix including:
an organic polymer binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof;
an inorganic aggregate filler having a concentration in a range from about 20% to about 90% by weight of solids in the inorganically filled matrix; and
a fibrous material substantially homogeneously dispersed throughout the inorganically filled matrix,
wherein the inorganically filled matrix includes organic components in an amount of at least about 5% by weight of solids within the inorganically filled matrix, and wherein the inorganically filled matrix has a thickness less than about 5 mm.
77. An article of manufacture as defined in claim 76, wherein the organic polymer binder is included in an amount in a range from about 1% to about 60% by weight of solids in the inorganically filled matrix.
78. An article of manufacture as defined in claim 76, wherein the organic polymer binder is included in an amount in a range from about 2% to about 30% by weight of solids in the inorganically filled matrix.
79. An article of manufacture as defined in claim 76, wherein the organic polymer binder is included in an amount in a range from about 5% to about 20% by weight of solids in the inorganically filled matrix.
80. An article of manufacture as defined in claim 76, wherein the organic polymer binder comprises a cellulosic material selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
81. An article of manufacture as defined in claim 76, wherein the organic polymer binder comprises a starch-based material selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrines, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
82. An article of manufacture as defined in claim 76, wherein the organic polymer binder comprises a protein-based material selected from the group consisting of prolamine,

collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
83. An article of manufacture as defined in claim 76, wherein the organic polymer binder comprises a polysaccharide selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
84. An article of manufacture as defined in claim 76, wherein the inorganically filled mixture further includes a synthetic organic polymer.
85. An article of manufacture as defined in claim 84, wherein the synthetic organic polymer is selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
86. An article of manufacture as defined in claim 76, wherein the inorganic aggregate filler is included in an amount in a range from about 20% to about 80% by weight of solids in the inorganically filled matrix.
87. An article of manufacture as defined in claim 76, wherein the inorganic aggregate filler is included in an amount in a range from about 30% to about 70% by weight of solids in the inorganically filled matrix.
88. An article of manufacture as defined in claim 76, wherein the inorganic aggregate filler comprises individual particles that are size optimized in order to achieve a predetermined particle packing density of the inorganic aggregate filler.
89. An article of manufacture as defined in claim 76, wherein the inorganic aggregate filler comprises a lightweight aggregate which reduces the density and increases the insulation ability of the inorganically filled matrix.
90. An article of manufacture as defined in claim 89, wherein the lightweight aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, xonotlite, aerogels, xerogels, tabular alumina, expanded clay, lightweight expanded geologic materials, pumice, microspheres, and mixtures thereof.
91. An article of manufacture as defined in claim 76, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, fused silica, alumina, metals, sand, gravel, sandstone, limestone, hydrated cement particles, calcium aluminate, glass beads, and mixtures thereof.
92. An article of manufacture as defined in claim 76, wherein the inorganically filled matrix further includes an organic aggregate selected from the group consisting of seeds, starches, gelatins, polymers, cork, agar materials, plastic spheres, and mixtures or derivatives thereof.
93. An article of manufacture as defined in claim 76, wherein the inorganically filled matrix further includes a hydraulically settable material.
94. An article of manufacture as defined in claim 76, wherein the fibrous material is included in an amount in a range from about 0.5% to about 60% by weight of solids in the inorganically filled matrix.
95. An article of manufacture as defined in claim 76, wherein the fibrous material is included in an amount in a range from about 2% to about 40% by weight of solids in the inorganically filled matrix.
96. An article of manufacture as defined in claim 76, wherein the fibrous material is included in an amount in a range from about 5% to about 20% by weight of solids in the inorganically filled matrix.
97. An article of manufacture as defined in claim 76, wherein the fibrous material comprises natural organic fibers.
98. An article of manufacture as defined in claim 97, wherein the natural organic fibers are selected from the group consisting of hemp fibers, sisal fibers, cotton fibers, bagasse fibers, abaca fibers, flax fibers, southern pine fibers, southern hardwood fibers, and mixtures thereof.
99. An article of manufacture as defined in claim 76, wherein the fibrous material comprises inorganic fibers.
100. An article of manufacture as defined in claim 99, wherein the inorganic fibers are selected from the group consisting of glass fibers, silica fibers, ceramic fibers, graphite fibers, metal fibers, and mixtures thereof.
101. An article of manufacture as defined in claim 76, wherein the fibrous material comprises synthetic organic fibers.
102. An article of manufacture as defined in claim 101, wherein the synthetic organic fibers are selected from the group consisting of plastic fibers, polyaramide fibers, polylactic acid fibers, polyethylene fibers, polypropylene fibers, and mixtures thereof.
103. An article of manufacture as defined in claim 76, wherein the fibrous material comprises individual fibers having an aspect ratio greater than about 10:1.
104. An article of manufacture as defined in claim 76, wherein the fibrous material comprises individual fibers having an aspect ratio greater than about 100:1.
105. An article of manufacture as defined in claim 76, wherein the fibrous material includes continuous fibers.
106. An article of manufacture as defined in claim 105, wherein the continuous fibers are wrapped around the inorganically filled matrix of the sealable container.
107. An article of manufacture as defined in claim 105, wherein the continuous fibers are embedded within the inorganically filled matrix of the sealable container.

108. An article of manufacture as defined in claim 105, wherein the continuous fibers are spiral wound.
109. An article of manufacture as defined in claim 76, wherein the fibrous material is selected from the group consisting of a fibrous mesh, mat, and fabric.
110. An article of manufacture as defined in claim 76, wherein the inorganically filled matrix has a thickness less than about 3 mm.
111. An article of manufacture as defined in claim 76, wherein the inorganically filled matrix has a thickness less than about 1 mm.
112. An article of manufacture as defined in claim 76, wherein the liquid-tight barrier is pressure-tight, wherein the sealable container has an interior and an exterior, and wherein the inorganically filled matrix can withstand a differential in pressure between the interior and the exterior of the sealable container of up to about 10 MPa of pressure.
113. An article of manufacture as defined in claim 76, further including a coating on at least a portion of a surface of the inorganically filled matrix of the sealable container.
114. An article of manufacture as defined in claim 113, wherein the coating renders the portion of the inorganically filled matrix impermeable to gases.
115. An article of manufacture as defined in claim 113, wherein the coating renders the portion of the inorganically filled matrix impermeable to liquids.
116. An article of manufacture as defined in claim 113, wherein the coating strengthens the portion of the inorganically filled matrix.
117. An article of manufacture as defined in claim 113, wherein the coating is selected from the group consisting of sodium silicate, orthosilicates, siloxanes, colloidal silica in organic polymer dispersions, colloidal silica in films, colloidal silica in fibers, calcium carbonate, kaolin clay, ceramics, and mixtures thereof.
118. An article of manufacture as defined in claim 113, wherein the coating is selected from the group consisting of biodegradable plastics, acrylics, polyacrylates, polyurethanes, melamines, polyethylene, synthetic polymers, hydroxypropylmethylcellulose, ethylcellulose, polyethylene glycol, prolamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polylactic acid, waxes, and mixtures thereof.
119. An article of manufacture as defined in claim 76, further including a liner on at least a portion of a surface of the inorganically filled matrix of the sealable container.
120. An article of manufacture as defined in claim 119, wherein the liner comprises blow-molded glass.
121. An article of manufacture as defined in claim 76, further including a laminated material on at least a portion of a surface of the inorganically filled matrix of the sealable container.
122. An article of manufacture as defined in claim 76, wherein the sealable container comprises a can.
123. An article of manufacture as defined in claim 76, wherein the sealable container comprises a carton.
124. An article of manufacture as defined in claim 76, wherein the sealable container comprises a box.
125. An article of manufacture as defined in claim 76, wherein the sealable container comprises a bottle.
126. An article of manufacture as defined in claim 76, wherein the sealable container comprises a jar.
127. An article of manufacture as defined in claim 76, wherein the sealable container comprises a pouch.
128. An article of manufacture as defined in claim 76, wherein the sealable container has a circular cross-section.
129. An article of manufacture as defined in claim 76, wherein the sealable container has a rectangular cross-section.
130. An article of manufacture as defined in claim 76, wherein the sealable container has a square-shaped cross-section.
131. An article of manufacture as defined in claim 76, wherein the sealable container has an oval-shaped cross-section.
132. An article of manufacture as defined in claim 76, wherein at least a portion of the inorganically filled matrix of the sheet is hinged.
133. An article of manufacture as defined in claim 76, wherein the sealable container has structural components comprising:
a hollow body portion having side walls connected to a bottom portion and an open end; and
a closure means for engaging the open end of the hollow body portion to seal substances within the sealable container.
134. An article of manufacture as defined in claim 76, wherein the sealable container has structural components comprising:
a hollow body portion having side walls connected to a bottom portion and an open end; and
a closure means for engaging the open end of the hollow body portion to seal substances within the sealable container, for dispensing substances, and for resealing substances within the sealable container.

135. An article of manufacture as defined in claim 76, wherein the sealable container has structural components comprising:
a hollow body portion having side walls connected to a bottom portion and an open end; and
a closure means for engaging the open end of the hollow body portion to seal substances within the sealable container and for dispensing substances.
136. An article of manufacture as defined in claim 135, wherein the bottom portion of the hollow body portion comprises a material selected from the group consisting of metals, glass, plastics, and paper composites.
137. An article of manufacture as defined in claim 135, wherein the side walls of the hollow body portion comprise a material selected from the group consisting of metals, glass, plastics, and paper composites.
138. An article of manufacture as defined in claim 135, wherein the closure means comprises a material selected from the group consisting of metals, glass, plastics, and paper composites.
139. An article of manufacture as defined in claim 135, wherein the bottom portion of the hollow body portion and the side walls of the hollow body portion are integrally formed together.
140. An article of manufacture as defined in claim 135, wherein the closure means comprises a lid.
141. An article of manufacture as defined in claim 135, wherein the closure means comprises a foil covering.
142. An article of manufacture as defined in claim 135, wherein the closure means comprises:
a top having a conical portion and a nozzle portion; and
a cap.
143. An article of manufacture as defined in claim 142, wherein the cap has internal threads and the nozzle portion of the top has complementary external threads configured to engage the internal threads of the cap to create a seal.
144. An article of manufacture as defined in claim 142, wherein the cap is a crimped bottle cap.
145. An article of manufacture as defined in claim 135, wherein the closure means comprises a flat cover and a pulltab.
146. An article of manufacture as defined in claim 135, wherein the closure means comprises a top and a spray mechanism.
147. An article of manufacture as defined in claim 76, wherein the sheet has been spiral wound to form the portion of the sealable container.
148. An article of manufacture as defined in claim 76, wherein the sheet has been rolled to form the portion of the sealable container.
149. An article of manufacture as defined in claim 76, wherein the sheet has been folded to form the portion of the sealable container.
150. An article of manufacture comprising a sealable container having a liquid-tight barrier, at least a substantial portion of the sealable container comprising a starch-bound sheet, the starch-bound sheet comprising:
a binding matrix including starch in an amount in a range from about 5% to about 90% by weight of solids in the starch-bound sheet and cellulosic ether in an amount in a range from about 0.5% to about 10% by weight of solids in the starch-bound sheet;
fibers substantially homogeneously dispersed throughout the binding matrix and having a concentration in an amount in a range from about 3% to about 40% by weight of solids in the starch-bound sheet; and
an inorganic filler in an amount in a range from 0% to about 90% by weight of solids in the starch-bound sheet,
wherein the starch-bound sheet has a thickness less than about 1 cm and a density greater than about 0.5 g/cm.sup.3.
151. An article of manufacture as defined in claim 150, wherein the starch is included in an amount in a range from about 15% to about 75% by weight of solids in the starch-bound sheet.
152. An article of manufacture as defined in claim 150, wherein the starch is included in an amount in a range from about 30% to about 70% by weight of solids in the starch-bound sheet.
153. An article of manufacture as defined in claim 150, wherein the starch comprises unmodified potato starch.
154. An article of manufacture as defined in claim 150, wherein the starch comprises unmodified corn starch.
155. An article of manufacture as defined in claim 150, wherein the starch comprises unmodified waxy corn starch.
156. An article of manufacture as defined in claim 150, wherein the cellulosic ether is included in an amount in a range from about 1% to about 5% by weight of solids in the starch-bound sheet.
157. An article of manufacture as defined in claim 150, wherein the cellulosic ether is included in an amount in a range from about 2% to about 4% by weight of solids in the starch-bound sheet.
158. An article of manufacture as defined in claim 150, wherein the cellulosic ether is selected from the group consisting of methylhydroxyethylcellulose,

hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
159. An article of manufacture as defined in claim 150, wherein the binding matrix further includes a protein-based material selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
160. An article of manufacture as defined in claim 150, wherein the binding matrix further includes a polysaccharide selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
161. An article of manufacture as defined in claim 150, wherein the binding matrix further includes a synthetic organic polymer.
162. An article of manufacture as defined in claim 161, wherein the synthetic organic polymer is selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
163. An article of manufacture as defined in claim 150, wherein the inorganic aggregate filler is included in an amount in a range from about 20% to about 80% by weight of solids in the starch-bound sheet.
164. An article of manufacture as defined in claim 150, wherein the inorganic aggregate filler is included in an amount in a range from about 30% to about 70% by weight of solids in the starch-bound sheet.
165. An article of manufacture as defined in claim 150, wherein the inorganic aggregate filler comprises a lightweight aggregate which reduces the density and increases the insulation ability of the starch-bound sheet.
166. An article of manufacture as defined in claim 165, wherein the lightweight aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, xonotlite, aerogels, xerogels, tabular alumina, expanded clay, lightweight expanded geologic materials, pumice, microspheres, and mixtures thereof.
167. An article of manufacture as defined in claim 150, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, fused silica, alumina, metals, sand, gravel, sandstone, limestone, hydrated cement particles, calcium aluminate, glass beads, and mixtures thereof.
168. An article of manufacture as defined in claim 150, wherein the starch-bound sheet further includes an organic aggregate selected from the group consisting of seeds, starches, gelatins, polymers, cork, agar materials, plastic spheres, and mixtures or derivatives thereof.
169. An article of manufacture as defined in claim 150, wherein the starch-bound sheet further includes a hydraulically settable material.
170. An article of manufacture as defined in claim 150, wherein the fibrous material is included in an amount in a range from about 5% to about 30% by weight of solids in the starch-bound sheet.
171. An article of manufacture as defined in claim 150, wherein the fibrous material is included in an amount in a range from about 7% to about 20% by weight of solids in the starch-bound sheet.
172. An article of manufacture as defined in claim 150, wherein the fibrous material comprises natural organic fibers.
173. An article of manufacture as defined in claim 172, wherein the natural organic fibers are selected from the group consisting of hemp fibers, sisal fibers, cotton fibers, bagasse fibers, abaca fibers, flax fibers, southern pine fibers, southern hardwood fibers, and mixtures thereof.
174. An article of manufacture as defined in claim 150, wherein the fibrous material comprises inorganic fibers.
175. An article of manufacture as defined in claim 174, wherein the inorganic fibers are selected from the group consisting of glass fibers, silica fibers, ceramic fibers, graphite fibers, metal fibers, and mixtures thereof.
176. An article of manufacture as defined in claim 150, wherein the fibrous material comprises synthetic organic fibers.
177. An article of manufacture as defined in claim 176, wherein the synthetic organic fibers are selected from the group consisting of plastic fibers, polyaramide fibers, polylactic acid fibers, polyethylene fibers, polypropylene fibers, and mixtures thereof.
178. An article of manufacture as defined in claim 150, wherein the fibrous material comprises individual fibers having an aspect ratio greater than about 10:1.
179. An article of manufacture as defined in claim 150, wherein the fibrous material comprises individual fibers having an aspect ratio greater than about 100:1.
180. An article of manufacture as defined in claim 150, wherein the fibrous material includes continuous fibers.
181. An article of manufacture as defined in claim 180, wherein the continuous fibers are wrapped around the starch-bound sheet of the sealable container.
182. An article of manufacture as defined in claim 180, wherein the continuous fibers are embedded within the starch-bound sheet of the sealable container.
183. An article of manufacture as defined in claim 180, wherein the continuous fibers are spiral wound.

184. An article of manufacture as defined in claim 150, wherein the fibrous material is selected from the group consisting of a fibrous mesh, mat, and fabric.
185. An article of manufacture as defined in claim 150, wherein the starch-bound sheet has a thickness less than about 5 mm.
186. An article of manufacture as defined in claim 150, wherein the starch-bound sheet has a thickness less than about 3 mm.
187. An article of manufacture as defined in claim 150, wherein the starch-bound sheet has a thickness less than about 1 mm.
188. An article of manufacture as defined in claim 150, wherein the liquid-tight barrier is pressure-tight, wherein the sealable container has an interior and an exterior, wherein the starch-bound sheet can withstand a differential in pressure between the interior and the exterior of the sealable container of up to about 10 MPa of pressure.
189. An article of manufacture as defined in claim 150, further including a coating on at least a portion of a surface of the starch-bound sheet of the sealable container.
190. An article of manufacture as defined in claim 189, wherein the coating renders the portion of the starch-bound sheet impermeable to gases.
191. An article of manufacture as defined in claim 189, wherein the coating renders the portion of the starch-bound sheet impermeable to liquids.
192. An article of manufacture as defined in claim 189, wherein the coating strengthens the portion of the starch-bound sheet.
193. An article of manufacture as defined in claim 189, wherein the coating is selected from the group consisting of sodium silicate, orthosilicates, siloxanes, colloidal silica in organic polymer dispersions, colloidal silica in films, colloidal silica in fibers, calcium carbonate, kaolin clay, ceramics, and mixtures thereof.
194. An article of manufacture as defined in claim 189, wherein the coating is selected from the group consisting of biodegradable plastics, acrylics, polyacrylates, polyurethanes, melamines, polyethylene, synthetic polymers, hydroxypropylmethylcellulose, ethylcellulose, polyethylene glycol, prolamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polylactic acid, waxes, and mixtures thereof.
195. An article of manufacture as defined in claim 150, further including a liner on at least a portion of a surface of the starch-bound sheet of the sealable container.
196. An article of manufacture as defined in claim 195, wherein the liner comprises blow-molded glass.
197. An article of manufacture as defined in claim 150, further including a laminated material on at least a portion of a surface of the starch-bound sheet of the sealable container.
198. An article of manufacture as defined in claim 150, wherein the sealable container comprises a can.
199. An article of manufacture as defined in claim 150, wherein the sealable container comprises a carton.
200. An article of manufacture as defined in claim 150, wherein the sealable container comprises a box.
201. An article of manufacture as defined in claim 150, wherein the sealable container comprises a bottle.
202. An article of manufacture as defined in claim 150, wherein the sealable container comprises a jar.
203. An article of manufacture as defined in claim 150, wherein the sealable container comprises a pouch.
204. An article of manufacture as defined in claim 150, wherein the sealable container has a circular cross-section.
205. An article of manufacture as defined in claim 150, wherein the sealable container has a rectangular cross-section.
206. An article of manufacture as defined in claim 150, wherein the sealable container has a square-shaped cross-section.
207. An article of manufacture as defined in claim 150, wherein the sealable container has an oval-shaped cross-section.
208. An article of manufacture as defined in claim 150, wherein at least a portion of the starch-bound sheet is hinged.
209. An article of manufacture as defined in claim 150, wherein the sealable container has structural components comprising:
a hollow body portion having side walls connected to a bottom portion and an open end; and
a closure means for engaging the open end of the hollow body portion to seal substances within the sealable container.
210. An article of manufacture as defined in claim 150, wherein the sealable container has structural components comprising:
a hollow body portion having side walls connected to a bottom portion and an open end; and
a closure means for engaging the open end of the hollow body portion to seal substances within the sealable container, for dispensing substances, and for resealing substances within the sealable container.
211. An article of manufacture as defined in claim 150, wherein the sealable container has structural components comprising:
a hollow body portion having side walls connected to a bottom portion and an open end;

and
a closure means for engaging the open end of the hollow body portion to seal substances within the sealable container and for dispensing substances.
212. An article of manufacture as defined in claim 211, wherein the bottom portion of the hollow body portion comprises a material selected from the group consisting of metals, glass, plastics, and paper composites.
213. An article of manufacture as defined in claim 211, wherein the side walls of the hollow body portion comprise a material selected from the group consisting of metals, glass, plastics, and paper composites.
214. An article of manufacture as defined in claim 211, wherein the closure means comprises a material selected from the group consisting of metals, glass, plastics, and paper composites.
215. An article of manufacture as defined in claim 211, wherein the bottom portion of the hollow body portion and the side walls of the hollow body portion are integrally formed together.
216. An article of manufacture as defined in claim 211, wherein the closure means comprises a lid.
217. An article of manufacture as defined in claim 211, wherein the closure means comprises a foil covering.
218. An article of manufacture as defined in claim 211, wherein the closure means comprises:
a top having a conical portion and a nozzle portion; and
a cap.
219. An article of manufacture as defined in claim 218, wherein the cap has internal threads and the nozzle portion of the top has complementary external threads configured to engage the internal threads of the cap to create a seal.
220. An article of manufacture as defined in claim 218, wherein the cap is a crimped bottle cap.
221. An article of manufacture as defined in claim 211, wherein the closure means comprises a flat cover and a pulltab.
222. An article of manufacture as defined in claim 211, wherein the closure means comprises a top and a spray mechanism.
223. An article of manufacture as defined in claim 150, wherein the starch-bound sheet has been spiral wound to form the portion of the sealable container.
224. An article of manufacture as defined in claim 150, wherein the starch-bound sheet has been rolled to form the portion of the sealable container.
225. An article of manufacture as defined in claim 150, wherein the starch-bound sheet has been folded to form the portion of the sealable container.

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TITLE: Methods for manufacturing articles from sheets having a highly inorganically filled organic polymer matrix

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CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. A method for manufacturing an article having an inorganically filled matrix, the method comprising the steps of:
mixing together water, a water-dispersible organic polymer binder, an aggregate material, and a fibrous material to form an inorganically filled moldable mixture in which the organic polymer binder is substantially solvated in the water;
forming the inorganically filled moldable mixture into an inorganically filled sheet without significant dewatering of the inorganically filled mixture;
evaporating a substantial portion of the water from the inorganically filled sheet in order to substantially dry the organic polymer binder in less than about 10 minutes after forming the sheet, thereby binding the aggregate material and fibrous material within the sheet, the sheet having a thickness in a range from about 0.01 mm to about 1 cm; and
fashioning at least a portion of the inorganically filled sheet into a desired shape of the article of manufacture.
2. A method for manufacturing an article as defined in claim 1, wherein the mixing step yields an inorganically filled moldable mixture in which the aggregate material has a concentration in a range from about 50% to about 95% by volume of total solids in the mixture.
3. A method for manufacturing an article as defined in claim 1, wherein the mixing step yields an inorganically filled moldable mixture in which the aggregate material has a concentration in a range from about 60% to about 80% by volume of total solids in the mixture.
4. A method for manufacturing an article as defined in claim 1, wherein the aggregate material comprises at least two different aggregate materials.
5. A method for manufacturing an article as defined in claim 1, wherein the aggregate material comprises individual particles that are size optimized in order to achieve a desired particle packing density of the aggregate material.
6. A method for manufacturing an article as defined in claim 5, wherein the particle packing density of the aggregate material is at least about 0.65.
7. A method for manufacturing an article as defined in claim 5, wherein the particle packing density of the aggregate material is at least about 0.85.
8. A method for manufacturing an article as defined in claim 1, wherein the aggregate material comprises a lightweight aggregate.
9. A method for manufacturing an article as defined in claim 8, wherein the lightweight aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.
10. A method for manufacturing an article as defined in claim 1, wherein the aggregate material is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
11. A method for manufacturing an article as defined in claim 1, wherein the aggregate material comprises an organic aggregate selected from the group consisting of seeds,

starches, gelatins, and agar-type materials.
12. A method for manufacturing an article as defined in claim 1, wherein the aggregate material includes an inorganic gel.
13. A method for manufacturing an article as defined in claim 12, wherein the inorganic gel is selected from the group consisting of silica gel, aluminum silicate gel, calcium silicate gel, and mixtures thereof.
14. A method for manufacturing an article as defined in claim 12, wherein the gel has a concentration within the sheet such that a desired amount of moisture is maintained within the inorganically filled matrix of the hardened inorganically filled sheet.
15. A method for manufacturing an article as defined in claim 1, wherein the aggregate material comprises a polymerized silicate.
16. A method for manufacturing an article as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 3 mm.
17. A method for manufacturing an article as defined in claim 1, wherein the inorganically filled matrix has a thickness less than about 1 mm.
18. A method for manufacturing an article as defined in claim 1, wherein the mixing step yields an inorganically filled moldable mixture in which the organic polymer binder and fibrous material have a combined concentration in a range from about 5% to about 60% by volume of total solids in the mixture.
19. A method for manufacturing an article as defined in claim 18, wherein the mixing step yields an inorganically filled moldable mixture in which the organic polymer binder and fibrous material have a combined concentration less than about 30% by volume of the total solids in the mixture.
20. A method for manufacturing an article as defined in claim 1, wherein the mixing step yields an inorganically filled moldable mixture in which the water-dispersible organic polymer binder has a concentration in a range from about 1% to about 50% by volume of total solids in the mixture.
21. A method for manufacturing an article as defined in claim 1, wherein the mixing step yields an inorganically filled moldable mixture in which the water-dispersible organic polymer binder in has a concentration a range from about 5% to about 20% by volume of total solids in the mixture.
22. A method for manufacturing an article as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a cellulose-based polymer.
23. A method for manufacturing an article as defined in claim 22, wherein the cellulose-based polymer is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
24. A method for manufacturing an article as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a starch-based polymer.
25. A method for manufacturing an article as defined in claim 24, wherein the starch-based polymer is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
26. A method for manufacturing an article as defined in claim 24, wherein the protein-based material is selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
27. A method for manufacturing an article as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a protein-based material.
28. A method for manufacturing an article as defined in claim 1, wherein the water-dispersible organic polymer binder is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
29. A method for manufacturing an article as defined in claim 1, wherein the water-dispersible organic polymer binder comprises a synthetic organic polymer.
30. A method for manufacturing an article as defined in claim 29, wherein the synthetic organic polymer is selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
31. A method for manufacturing an article as defined in claim 1, wherein the fibrous material has a concentration in a range from about 0.5% to about 50% by volume of total solids in the sheet.
32. A method for manufacturing an article as defined in claim 1, wherein the fibrous material has a concentration in a range from about 15% to about 30% by volume of total solids in the sheet.
33. A method for manufacturing an article as defined in claim 1, wherein the fibrous material comprises organic fibers.
34. A method for manufacturing an article as defined in claim 33, wherein the organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, and southern hardwood fibers, and mixtures thereof.
35. A method for manufacturing an article as defined in claim 1, wherein the fibrous

material comprises inorganic fibers.
36. A method for manufacturing an article as defined in claim 35, wherein the inorganic fibers are selected from the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.
37. A method for manufacturing an article as defined in claim 1, wherein the fibrous material comprises a mixture of different fibers having varying strengths and flexibilities.
38. A method for manufacturing an article as defined in claim 1, wherein the fibrous material includes individual fibers having an aspect ratio of at least about 10:1.
39. A method for manufacturing an article as defined in claim 1, wherein the fibrous material includes individual fibers having an average aspect ratio of at least about 100:1.
40. A method for manufacturing an article as defined in claim 1, wherein the fibrous material includes individual fibers having an average aspect ratio of at least about 1000:1.
41. A method for manufacturing an article as defined in claim 1, wherein the inorganically filled matrix has a tensile strength in a range from about 0.05 MPa to about 60 MPa.
42. A method for manufacturing an article as defined in claim 1, wherein the inorganically filled matrix has a tensile strength to bulk density ratio in a range from about 2 MPa-cm.sup.3 /g to about 200 MPa-cm.sup.3 /g.
43. A method for manufacturing an article as defined in claim 1, wherein the inorganically filled matrix has a tensile strength to bulk density ratio in a range from about 3 MPa-cm.sup.3 /g to about 50 MPa-cm.sup.3 /g.
44. A method for manufacturing an article as defined in claim 1, wherein the aggregate material includes a hydraulically settable material.
45. A method for manufacturing an article as defined in claim 44, wherein the hydraulically settable material comprises a hydraulic cement.
46. A method for manufacturing an article as defined in claim 45, wherein the hydraulic cement comprises portland grey cement.
47. A method for manufacturing an article as defined in claim 45, wherein the hydraulic cement is selected from the group consisting of portland white cement, slag cement, calcium aluminate cement, silicate cement, phosphate cement, high-alumina cement, magnesium oxychloride cement, aggregates coated with microfine cement particles, MDF cement, DSP cement, Pyrament cement, Densit cement, and mixtures thereof.
48. A method for manufacturing an article as defined in claim 44, wherein the hydraulically settable material comprises calcium sulfate hemihydrate or calcium oxide.
49. A method for manufacturing an article as defined in claim 44, wherein the hydraulically settable material has a concentration within the inorganically filled matrix sufficient to import a degree of binding of the components in the inorganically filled matrix.
50. A method for manufacturing an article as defined in claim 1, wherein the inorganically filled matrix has a maximum bulk density of about 2 g/cm.sup.3.
51. A method for manufacturing an article as defined in claim 1, wherein the inorganically filled matrix has a bulk density in a range from about 0.4 g/cm.sup.3 to about 1.5 g/cm.sup.3.
52. A method for manufacturing an article as defined in claim 1, wherein the inorganically filled sheet obtained in the sheet forming step can elongate up to about 20% without completely fracturing.
53. A method for manufacturing an article as defined in claim 1, wherein the substantially hardened sheet can elongate from about 0.5% to about 8% without completely fracturing.
54. A method for manufacturing an article as defined in claim 1, wherein the water has a concentration in a range from about 5% to about 50% by volume of the inorganically filled mixture.
55. A method for manufacturing an article as defined in claim 1, wherein the inorganically filled matrix includes finely dispersed air voids.
56. A method for manufacturing an article as defined in claim 1, wherein the fibrous material comprises individual fibers which have a substantially random orientation within the inorganically filled matrix.
57. A method for manufacturing an article as defined in claim 1, wherein the fibrous material comprises individual fibers which have a substantially unidirectional orientation within the inorganically filled matrix.
58. A method for manufacturing an article as defined in claim 1, wherein the fibrous material comprises individual fibers which have a substantially bidirectional orientation within the inorganically filled matrix.
59. A method for manufacturing an article as defined in claim 1, wherein the inorganically filled matrix has a surface and an interior and wherein the fibrous material comprises individual fibers which have a substantially higher level of directional orientation at or near the surface of the inorganically filled matrix compared to fibers within the interior of the matrix.
60. A method for manufacturing an article as defined in claim 1, wherein the sheet forming step includes extruding the inorganically filled mixture between a pair of extruding rollers.

61. A method for manufacturing an article as defined in claim 1, wherein the sheet forming step includes extruding the inorganically filled mixture through a die to form the inorganically filled sheet.
62. A method for manufacturing an article as defined in claim 61, wherein the sheet forming step includes passing the extruded sheet between a pair of rollers.
63. A method for manufacturing an article as defined in claim 1, further including the step of compacting the sheet.
64. A method for manufacturing an article as defined in claim 1, wherein the fashioning step includes fashioning at least a portion of the inorganically filled sheet into a container.
65. A method for manufacturing an article as defined in claim 64, wherein the container comprises a food or beverage container.
66. A method for manufacturing an article as defined in claim 1, wherein the sheet formed from the inorganically-filled mixture achieves form stability in a time period sufficiently short for the article of manufacture to be mass-producible.
67. A method for manufacturing an article having an inorganically filled matrix as defined in claim 1, wherein the mixing step yields an inorganically filled moldable mixture in which the aggregate material has a concentration in a range from about 40% to about 98% by volume of total solids in the mixture.
68. A method for manufacturing an article of manufacture, the method comprising the steps of:
forming a substantially dried inorganically filled sheet without significant dewatering from an inorganically filled mixture including water, a water-dispersible organic polymer binder, an aggregate material, and a fibrous material, the organic polymer binder being substantially solvated in the water, the sheet being formed by passing the inorganically filled mixture between forming rollers to form a green sheet and then evaporating a substantial portion of the water from the green sheet in order to substantially dry the organic polymer binder in less than about 10 minutes after forming the green sheet, thereby forming the substantially dried inorganically filled sheet and binding the aggregate material and fibrous material in the sheet; and
fashioning at least a portion of the substantially dried inorganically filled sheet into a desired shape of the article of manufacture.
69. A method for manufacturing an article as defined in claim 68, further comprising the step of moistening the substantially dried inorganically filled sheet in order to increase its flexibility.
70. A method for manufacturing an article as defined in claim 68, further comprising the step of laminating the inorganically filled sheet with another sheet.
71. A method for manufacturing an article as defined in claim 70, wherein the other sheet comprises another inorganically filled sheet.
72. A method for manufacturing an article as defined in claim 70, wherein the other sheet comprises a noninorganically filled sheet.
73. A method for manufacturing an article as defined in claim 72, wherein the noninorganically filled sheet is selected from the group consisting of organic polymer sheets, metal foil sheets, fiber sheet, ceramic sheets, ionomer sheets, elastomeric sheets, plastic sheets, cellophane sheets, nylon sheets, wax sheets, and metallized film sheets, and combinations of the foregoing.
74. A method for manufacturing an article as defined in claim 68, further comprising the step of corrugating the inorganically filled sheet.
75. A method for manufacturing an article as defined in claim 74, wherein the corrugated sheet is laminated with another sheet to form a corrugated laminate structure.
76. A method for manufacturing an article as defined in claim 68, further comprising the step of creping the inorganically filled sheet.
77. A method for manufacturing an article as defined in claim 68, further comprising the step of coating a surface of the inorganically filled sheet with a coating material.
78. A method for manufacturing an article as defined in claim 77, wherein the coating material is selected from the group consisting of edible oils, melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, and mixtures or derivatives thereof.
79. A method for manufacturing an article as defined in claim 77, wherein the coating material comprises a biodegradable material.
80. A method for manufacturing an article as defined in claim 77, wherein the coating material is selected from the group consisting of sodium silicate, calcium carbonate, aluminum oxide, silicon oxide, clay, kaolin, and ceramic.
81. A method for manufacturing an article as defined in claim 77, wherein the coating renders the article more resistant to water penetration.
82. A method for manufacturing an article as defined in claim 77, wherein the coating renders the article more resistant to penetration of grease or oils.
83. A method for manufacturing an article as defined in claim 77, wherein the coating material renders the article more liquid-tight.
84. A method for manufacturing an article as defined in claim 77, wherein the coating material renders the article more pressure-tight.
85. A method for manufacturing an article as defined in claim 77, wherein the coating

material renders the inorganically filled matrix more flexible.
86. A method for manufacturing an article as defined in claim 68, further comprising the step of applying an indicia to the inorganically filled sheet.
87. A method for manufacturing an article as defined in claim 68, further comprising the step of scoring the inorganically filled sheet.
88. A method for manufacturing an article as defined in claim 68, further comprising the step of score cutting the inorganically filled sheet.
89. A method for manufacturing an article as defined in claim 68, further comprising the step of perforating the inorganically filled sheet.
90. A method for manufacturing an article as defined in claim 68, further comprising the step of cutting a continuous inorganically filled sheet into individual sheets.
91. A method for manufacturing an article as defined in claim 68, further comprising the step of slotting the inorganically filled sheet to aid in forming flaps of a container.
92. A method for manufacturing an article as defined in claim 68, wherein the inorganically filled sheet is transparent.
93. A method for manufacturing an article as defined in claim 68, wherein the inorganically filled sheet is translucent.
94. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises the step of cutting a portion of the inorganically filled sheet into the desired shape of the article.
95. A method for manufacturing an article as defined in claim 68, wherein the fashioning step includes seaming a portion of the inorganically filled sheet.
96. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises folding a portion of the sheet into the desired shape of the article.
97. A method for manufacturing an article as defined in claim 96, wherein folding involves mechanical interlocking devices.
98. A method for manufacturing an article as defined in claim 96, wherein the article is selected from the group consisting of cartons, boxes, corrugated boxes, sandwich containers, hinged clam-shell containers, dry cereal boxes, milk cartons, fruit juice containers, carriers for beverage containers, ice cream cartons, pleated cups, cone cups, french-fry scoops, fast-food carryout boxes, wraparound casing, open ended bags, and envelopes.
99. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises the steps of:
cutting a portion of the inorganically filled sheet into a sidewall blank having two straight ends;
convoluting the sidewall blank by overlapping the two straight ends of the sidewall blank to form a sidewall of a cup;
cutting a portion of the inorganically filled sheet into a bottom portion blank;
configuring the bottom portion blank into a bottom portion of a cup; and
assembling the convoluted sidewall and bottom portion together in order to form a two-piece cup.
100. A method for manufacturing an article as defined in claim 99, further comprising the step of seaming together the convoluted sidewall and bottom portion.
101. A method for manufacturing an article as defined in claim 99, further comprising the step of seaming the two straight ends of the convoluted sidewall together.
102. A method for manufacturing an article as defined in claim 99, further comprising the step of modifying the opening of the cup to form a lip.
103. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises convoluting a portion of the sheet into the desired shape of the article of manufacture.
104. A method for manufacturing an article as defined in claim 103, wherein the article is selected from the group consisting of a can, a frozen juice concentrate container, a potato chip container, an ice cream container, a salt container, a detergent container, a motor oil container, a tube, a cone cup, and a mailing tube.
105. A method for manufacturing an article as defined in claim 104, further including the step of attaching closure means for engaging an open end of the article.
106. A method for manufacturing an article as defined in claim 103, further comprising the step of winding continuous fibers around the article.
107. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises spiral winding at least a portion of the sheet into the desired shape of the article.
108. A method for manufacturing an article as defined in claim 107, wherein the article is selected from the group consisting of a cup, a can, a frozen juice concentrate container, a potato chip container, an ice cream container, a salt container, a detergent container, a motor oil container, and a mailing tube.
109. A method for manufacturing an article as defined in claim 108, further including the step of attaching closure means for engaging an open end of the article.
110. A method for manufacturing an article as defined in claim 107, further comprising the step of winding continuous fibers around the article.
111. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises pressing a portion of the sheet into the desired shape of the article.
112. A method for manufacturing an article as defined in claim 111, wherein the fashioning step yields an article selected from the group consisting of a plate, a

vending plate, a pie plate, a tray, a baking tray, a bowl, a breakfast platter, a microwaveable dinner tray, a TV dinner tray, an egg carton, a meat packaging platter, a dish, and a lid.

113. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises assembling a blank cut from the inorganically filled sheet with at least one other blank.

114. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises the steps of:
cutting the inorganically filled sheet into a box body blank and a lid blank;
scoring the box body blank and the lid blank to enable folding of the box body blank into a box body and the lid blank into a lid;
folding the box body blank into a box body having corners and the lid blank into a lid having corners; and
staying the corners of the box body and the lid to form a rigid setup box.

115. A method for manufacturing an article as defined in claim 114, further comprising the step of wrapping the rigid setup box with a cover sheet.

116. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises the steps of:
cutting a portion of the inorganically filled sheet into a support card;
providing a cover; and
assembling the support card and the cover to form a carded packaging container.

117. A method for manufacturing an article as defined in claim 116, wherein at least a portion of the cover is formed from a translucent inorganically filled sheet.

118. A method for manufacturing an article as defined in claim 116, wherein the cover comprises a plastic material.

119. A method for manufacturing an article as defined in claim 118, wherein the cover is a rigid blister.

120. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises forming a pouch from at least a portion of the inorganically filled sheet.

121. A method for manufacturing an article as defined in claim 120, further comprising the step of seaming a portion of the pouch.

122. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises the steps of:
advancing the inorganically filled sheet horizontally along a length of the sheet;
folding the inorganically filled sheet in half along the length of the inorganically filled sheet;
seaming the inorganically filled sheet at intervals to form a series of pouches; and
closing the pouches by seaming after each pouch has been filled with a product.

123. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises the steps of:
advancing the inorganically filled sheet vertically along a length of the sheet;
folding the inorganically filled sheet into a tube along the length of the inorganically filled sheet;
seaming the inorganically filled sheet at intervals to form a series of pouches; and
closing the pouches by seaming after each pouch has been filled with a product.

124. A method for manufacturing an article as defined in claim 68, wherein the fashioning step comprises the steps of:
placing a product on the inorganically filled sheet at intervals;
draping a second sheet over the product and the inorganically filled sheet in a manner that provides contact between the inorganically filled sheet and the second sheet; and
seaming the inorganically filled sheet and the second sheet together at intervals to form a series of pouches.

125. A method for manufacturing an article as defined in claim 124, wherein the second sheet is an inorganically filled sheet.

126. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields an article of manufacture comprising a container with a liner.

127. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields an article of manufacture comprising a magazine.

128. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields an article of manufacture comprising a book cover.

129. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields an article of manufacture comprising a notebook.

130. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields an article of manufacture comprising a more rigid sheet having a thickness up to about 3 cm.

131. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields and article of manufacture that is substantially flat.

132. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields an article of manufacture that is substantially curved.

133. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields an article of manufacture having a substantially curved cross-section.

134. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields an article of manufacture having a substantially oval cross-section.

135. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields an article of manufacture having a substantially rectangular cross-section.
136. A method for manufacturing an article as defined in claim 68, wherein the fashioning step yields an article of manufacture having a substantially triangular cross-section.
137. A method for manufacturing an article of manufacture, the method comprising the steps of:
(a) mixing together water, a water-dispersible organic polymer binder, an aggregate material, and a fibrous material to form an inorganically filled moldable mixture in which the organic polymer binder is substantially solvated in the water;
(b) forming the inorganically filled moldable mixture into an inorganically filled sheet without significant dewatering by passing the mixture between forming rollers;
(c) evaporating a substantial portion of the water from the inorganically filled sheet in order to substantially dry the organic polymer binder in less than about 10 minutes after forming the sheet and thereby bind the aggregate material and fibrous material within the sheet, the inorganically filled sheet having a thickness in a range from about 0.01 mm to about 1 cm;
(d) rolling the inorganically filled sheet obtained in step (c) onto a spool; and
(e) removing a portion of the inorganically filled sheet from the spool and fashioning it into a desired shape of the article of manufacture.
138. A method for manufacturing an article as defined in claim 137, wherein the mixing step yields an inorganically filled moldable mixture in which the aggregate material has a concentration in a range from about 40% to about 98% by volume of total solids in the mixture.
139. A method for manufacturing an article as defined in claim 137, wherein the mixing step yields an inorganically filled moldable mixture in which the aggregate material has a concentration in a range from about 50% to about 95% by volume of total solids in the mixture.
140. A method for manufacturing an article as defined in claim 137, wherein the mixing step yields an inorganically filled moldable mixture in which the aggregate material has a concentration in a range from about 60% to about 80% by volume of total solids in the mixture.
141. A method for manufacturing an article as defined in claim 137, wherein the aggregate material comprises a lightweight aggregate.
142. A method for manufacturing an article as defined in claim 141, wherein the lightweight aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.
143. A method for manufacturing an article as defined in claim 137, wherein the aggregate material is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.
144. A method for manufacturing an article as defined in claim 137, wherein the aggregate material comprises an organic aggregate selected from the group consisting of seeds, starches, gelatins, and agar-type materials.
145. A method for manufacturing an article as defined in claim 137, wherein the aggregate material includes an inorganic gel.
146. A method for manufacturing an article as defined in claim 145, wherein the inorganic gel is selected from the group consisting of silica gel, aluminum silicate gel, calcium silicate gel, and mixtures thereof.
147. A method for manufacturing an article as defined in claim 137, wherein the inorganically filled matrix has a thickness less than about 3 mm.
148. A method for manufacturing an article as defined in claim 137, wherein the inorganically filled matrix has a thickness less than about 1 mm.
149. A method for manufacturing an article as defined in claim 137, wherein the mixing step yields an inorganically filled moldable mixture in which the water-dispersible organic polymer binder has a concentration in a range from about 1% to about 50% by volume of total solids in the mixture.
150. A method for manufacturing an article as defined in claim 137, wherein the mixing step yields an inorganically filled moldable mixture in which the water-dispersible organic polymer binder in has a concentration a range from about 5% to about 20% by volume of total solids in the mixture.
151. A method for manufacturing an article as defined in claim 137, wherein the water-dispersible organic polymer binder comprises a cellulose-based polymer.
152. A method for manufacturing an article as defined in claim 151, wherein the cellulose-based polymer is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
153. A method for manufacturing an article as defined in claim 137, wherein the water-dispersible organic polymer binder comprises a starch-based polymer.
154. A method for manufacturing an article as defined in claim 153, wherein the starch-based polymer is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.

155. A method for manufacturing an article as defined in claim 137, wherein the water-dispersible organic polymer binder comprises a protein-based material.
156. A method for manufacturing an article as defined in claim 155, wherein the protein-based material is selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
157. A method for manufacturing an article as defined in claim 137, wherein the water-dispersible organic polymer binder is selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
158. A method for manufacturing an article as defined in claim 137, wherein the water-dispersible organic polymer binder comprises a synthetic organic polymer selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
159. A method for manufacturing an article as defined in claim 137, wherein the mixing step yields an inorganically filled moldable mixture in which the fibrous material has a concentration in a range from about 0.5% to about 50% by volume of total solids in the mixture.
160. A method for manufacturing an article as defined in claim 137, wherein the mixing step yields an inorganically filled moldable mixture in which the fibrous material has a concentration in a range from about 15% to about 30% by volume of total solids in the mixture.
161. A method for manufacturing an article as defined in claim 137, wherein the fibrous material comprises organic fibers.
162. A method for manufacturing an article as defined in claim 161, wherein the organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, and southern hardwood fibers, and mixtures thereof.
163. A method for manufacturing an article as defined in claim 137, wherein the fibrous material comprises inorganic fibers.
164. A method for manufacturing an article as defined in claim 163, wherein the inorganic fibers are selected from the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.
165. A method for manufacturing an article as defined in claim 137, wherein the sheet forming step further includes extruding the inorganically filled mixture through a die to form a sheet that is subsequently passed between the forming rollers.
166. A method for manufacturing an article as defined in claim 137, further including the step of compacting the sheet.
167. A method for manufacturing an article as defined in claim 137, wherein the fashioning step includes fashioning at least a portion of the inorganically filled sheet into a container.
168. A method for manufacturing an article as defined in claim 137, further comprising the step of remoistening the substantially dried inorganically filled sheet in order to increase its flexibility.
169. A method for manufacturing an article as defined in claim 137, further comprising the step of laminating the inorganically filled sheet with another sheet.
170. A method for manufacturing an article as defined in claim 169, wherein the other sheet comprises another inorganically filled sheet.
171. A method for manufacturing an article as defined, in claim 169, wherein the other sheet comprises a sheet selected from the group consisting of organic polymer sheets, metal foil sheets, fiber sheet, ceramic sheets, ionomer sheets, elastomeric sheets, plastic sheets, cellophane sheets, nylon sheets, wax sheets, and metallized film sheets, and combinations of the foregoing.
172. A method for manufacturing an article as defined in claim 137, further comprising the step of corrugating the inorganically filled sheet.
173. A method for manufacturing an article as defined in claim 137, further comprising the step of coating a surface of the inorganically filled sheet with a coating material.
174. A method for manufacturing an article as defined in claim 173, wherein the coating material is selected from the group consisting of edible oils, melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, and mixtures or derivatives thereof.
175. A method for manufacturing an article as defined in claim 173, wherein the coating material comprises a biodegradable material.
176. A method for manufacturing an article as defined in claim 173, wherein the coating material is selected from the group consisting of sodium silicate, calcium carbonate, aluminum oxide, silicon oxide, clay, kaolin, and ceramic.
177. A method for manufacturing an article as defined in claim 173, wherein the coating renders the article more resistant to water penetration.
178. A method for manufacturing an article as defined in claim 173, wherein the coating renders the article more resistant to penetration of grease or oils.
179. A method for manufacturing an article as defined in claim 173, wherein the coating material renders the article more liquid-tight.

180. A method for manufacturing an article as defined in claim 173, wherein the coating material renders the inorganically filled matrix more flexible.
181. A method for manufacturing an article as defined in claim 137, further comprising the step of scoring the inorganically filled sheet.
182. A method for manufacturing an article as defined in claim 137, further comprising the step of perforating the inorganically filled sheet.
183. A method for manufacturing an article as defined in claim 137, wherein the fashioning step comprises folding a portion of the sheet into the desired shape of the article.
184. A method for manufacturing an article as defined in claim 183, wherein the article is selected from the group consisting of cartons, boxes, corrugated boxes, sandwich containers, hinged lid shell containers, dry cereal boxes, milk cartons, fruit juice containers, carriers for beverage containers, ice cream cartons, pleated cups, cone cups, french-fry scoops, fast-food carryout boxes, wraparound casing, open ended bags, and envelopes.
185. A method for manufacturing an article as defined in claim 137, wherein the fashioning step comprises the steps of:
cutting a portion of the inorganically filled sheet into a sidewall blank having two straight ends;
convoluting the sidewall blank by overlapping the two straight ends of the sidewall blank to form a sidewall of a cup;
cutting a portion of the inorganically filled sheet into a bottom portion blank;
configuring the bottom portion blank into a bottom portion of a cup; and
assembling the convoluted sidewall and bottom portion together in order to form a two-piece cup.
186. A method for manufacturing an article as defined in claim 137, wherein the fashioning step comprises convoluting a portion of the sheet into the desired shape of the article of manufacture.
187. A method for manufacturing an article as defined in claim 137, further comprising the step of winding continuous fibers around the article.
188. A method for manufacturing an article as defined in claim 137, wherein the fashioning step comprises spiral winding at least a portion of the sheet into the desired shape of the article.
189. A method for manufacturing an article as defined in claim 137, wherein the fashioning step comprises pressing a portion of the sheet into the desired shape of the article.
190. A method for manufacturing an article as defined in claim 137, wherein the fashioning step comprises forming a pouch from at least a portion of the inorganically filled sheet.
191. A method for manufacturing an article as defined in claim 190, further comprising the step of seaming a portion of the pouch.
192. A method for manufacturing an article as defined in claim 137, wherein the fashioning step yields an article of manufacture comprising a container with a liner.
193. A method for manufacturing an article of manufacture, the method comprising the steps of:
(a) forming a substantially dried inorganically filled sheet without significant dewatering from an inorganically filled mixture including water, a water-dispersible organic polymer binder, an aggregate material, and a fibrous material, the organic polymer binder being substantially solvated in the water, the sheet being formed by passing the inorganically filled mixture between forming rollers to form a green sheet and then evaporating a substantial portion of the water from the green sheet in order to substantially dry the organic polymer binder in less than about 10 minutes after forming the green sheet, thereby forming the substantially dried inorganically filled sheet and binding the aggregate material and fibrous material in the sheet;
(b) winding the substantially dried inorganically filled sheet obtained in step (a) onto a spool; and
(c) removing a portion of the substantially dried inorganically filled sheet from the spool and fashioning into a desired shape of the article of manufacture.
194. A method for manufacturing an article as defined in claim 193, wherein the mixing step yields an inorganically filled moldable mixture in which the aggregate material has a concentration in a range from about 40% to about 98% by volume of total solids in the mixture.
195. A method for manufacturing an article as defined in claim 193, wherein the mixing step yields an inorganically filled moldable mixture in which the aggregate material has a concentration in a range from about 50% to about 95% by volume of total solids in the mixture.
196. A method for manufacturing an article as defined in claims 193, wherein the mixing step yields an inorganically filled moldable mixture in which the aggregate material has a concentration in a range from about 60% to about 80% by volume of total solids in the mixture.
197. A method for manufacturing an article as defined in claim 193, wherein the aggregate material comprises a lightweight aggregate.
198. A method for manufacturing an article as defined in claim 197, wherein the lightweight aggregate is selected from the group consisting of perlite, vermiculite,

hollow glass spher[illegible]rous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtur[illegible]reof.
199. A method for [illegible]cturing an article as defined in claim 193, wherein the aggregate material is select[illegible]m the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, s[illegible]ravel, sandstone, limestone, and mixtures thereof.
200. A method for [illegible]cturing an article as defined in claim 193, wherein the aggregate material comprises [illegible]ganic aggregate selected from the group consisting of seeds, starches, gelatins, [illegible]agar-type materials.
201. A method for m[illegible]cturing an article as defined in claim 193, wherein the aggregate material includes [illegible]rganic gel.
202. A method for [illegible]cturing an article as defined in claim 201, wherein the inorganic gel is selected fr[illegible] group consisting of silica gel, aluminum silicate gel, calcium silicate gel, and [illegible]es thereof.
203. A method for [illegible]cturing an article as defined in claim 193, wherein the inorganically fill[illegible]rix has a thickness less than about 3 mm.
204. A method for [illegible]cturing an article as defined in claim 193, wherein the inorganically fill[illegible]rix has a thickness less than about 1 mm.
205. A method for m[illegible]cturing an article as defined in claim 193, wherein the mixing step yields an inor[illegible]ally filled moldable mixture in which the water-dispersible organic polymer bi[illegible]as a concentration in a range from about 1% to about 50% by volume of total sc[illegible]n the mixture.
206. A method for [illegible]cturing an article as defined in claim 193, wherein the mixing step yields an inc[illegible]ally filled moldable mixture in which the water-dispersible organic polymer bi[illegible]n has a concentration a range from about 5% to about 20% by volume of total sc[illegible]n the mixture.
207. A method for [illegible]cturing an article as defined in claim 193, wherein the water-dispersible [illegible]c polymer binder comprises a cellulose-based polymer.
208. A method for m[illegible]cturing an article as defined in claim 207, wherein the cellulose-based po[illegible]is selected from the group consisting of methylhydroxyethyl[illegible]ose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, e[illegible]llulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or deriva[illegible]ves thereof.
209. A method for [illegible]cturing an article as defined in claim 193, wherein the water-dispersible [illegible]c polymer binder comprises a starch-based polymer.
210. A method for [illegible]cturing an article as defined in claim 209, wherein the starch-based polym[illegible]is selected from the group consisting of amylopectin, amylose, seagel, starch ace[illegible] starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dex[illegible] amine starches, phosphate starches, dialdehyde starches, and mixtures or deriva[illegible]thereof.
211. A method for [illegible]cturing an article as defined in claim 193, wherein the water-dispersible [illegible]c polymer binder comprises a protein-based material.
212. A method for [illegible]cturing an article as defined in claim 211, wherein the protein-based mate[illegible]is selected from the group consisting of prolamine, collagen, gelatin, glue, cas[illegible]nd mixtures or derivatives thereof.
213. A method for [illegible]cturing an article as defined in claim 193, wherein the water-dispersible [illegible]c polymer binder is selected from the group consisting of alginic acid, phycocolloid[illegible], gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mi[illegible]or derivatives thereof.
214. A method for [illegible]cturing an article as defined in claim 193, wherein the water-dispersible [illegible]c polymer binder comprises a synthetic organic polymer selected from the group con[illegible]ng of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinyl [illegible]ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic a[illegible], polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide pol[illegible]rs synthetic clay, latex, and mixtures or derivatives thereof.
215. A method for [illegible]cturing an article as defined in claim 193, wherein the mixing step yields an inc[illegible]ally filled mixture in which the fibrous material has a concentration in a [illegible] from about 0.5% to about 50% by volume of total solids in the mixture.
216. A method for [illegible]cturing an article as defined in claim 193, wherein the mixing step yields an inc[illegible]ally filled mixture in which the fibrous material has a concentration in a [illegible] from about 15% to about 30% by volume of total solids in the mixture.
217. A method for [illegible]cturing an article as defined in claim 193, wherein the fibrous material comprises [illegible]ic fibers.
218. A method for [illegible]cturing an article as defined in claim 217, wherein the organic fibers are selecte[illegible]the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, and [illegible]ern hardwood fibers, and mixtures thereof.
219. A method for [illegible]cturing an article as defined in claim 193, wherein the fibrous material comprises [illegible]nic fibers.
220. A method for [illegible]cturing an article as defined in claim 219, wherein the inorganic fibers are selecte[illegible]n the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fib[illegible], metal fibers, and mixtures thereof.
221. A method for [illegible]cturing an article as defined in claim 193, wherein the sheet forming step furth[illegible]cludes extruding the inorganically filled mixture through a die to

form a sheet that is subsequently passed between the forming rollers.
222. A method for manufacturing an article as defined in claim 193, further including the step of compacting the sheet.
223. A method for manufacturing an article as defined in claim 193, wherein the fashioning step includes fashioning at least a portion of the inorganically filled sheet into a container.
224. A method for manufacturing an article as defined in claim 193, further comprising the step of remoisturizing the substantially dried inorganically filled sheet in order to increase its flexibility.
225. A method for manufacturing an article as defined in claim 193, further comprising the step of laminating the inorganically filled sheet with another sheet.
226. A method for manufacturing an article as defined in claim 225, wherein the other sheet comprises another inorganically filled sheet.
227. A method for manufacturing an article as defined in claim 225, wherein the other sheet comprises a sheet selected from the group consisting of organic polymer sheets, metal foil sheets, paper sheet, ceramic sheets, ionomer sheets, elastomeric sheets, plastic sheets, cellophane sheets, nylon sheets, wax sheets, and metallized film sheets, and combinations of the foregoing.
228. A method for manufacturing an article as defined in claim 193, further comprising the step of corrugating the inorganically filled sheet.
229. A method for manufacturing an article as defined in claim 193, further comprising the step of coating a surface of the inorganically filled sheet with a coating material.
230. A method for manufacturing an article as defined in claim 229, wherein the coating material is selected from the group consisting of edible oils, melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy protein, polyethylene, synthetic polymers, waxes, elastomers, and mixtures or derivatives thereof.
231. A method for manufacturing an article as defined in claim 229, wherein the coating material comprises a biodegradable material.
232. A method for manufacturing an article as defined in claim 229, wherein the coating material is selected from the group consisting of sodium silicate, calcium carbonate, aluminum oxide, silicon oxide, clay, kaolin, and ceramic.
233. A method for manufacturing an article as defined in claim 229, wherein the coating renders the article resistant to water penetration.
234. A method for manufacturing an article as defined in claim 229, wherein the coating renders the article resistant to penetration of grease or oils.
235. A method for manufacturing an article as defined in claim 229, wherein the coating material renders the article more liquid-tight.
236. A method for manufacturing an article as defined in claim 229, wherein the coating material renders the inorganically filled sheet more flexible.
237. A method for manufacturing an article as defined in claim 193, further comprising the step of scoring the inorganically filled sheet.
238. A method for manufacturing an article as defined in claim 193, further comprising the step of perforating the inorganically filled sheet.
239. A method for manufacturing an article as defined in claim 193, wherein the fashioning step comprises folding a portion of the sheet into the desired shape of the article.
240. A method for manufacturing an article as defined in claim 239, wherein the article is selected from the group consisting of cartons, boxes, corrugated boxes, sandwich containers, hinged shell containers, dry cereal boxes, milk cartons, fruit juice containers, carriers, beverage containers, ice cream cartons, pleated cups, cone cups, french-fry scoops, food carryout boxes, wraparound casing, open ended bags, and envelopes.
241. A method for manufacturing an article as defined in claim 193, wherein the fashioning step comprises the steps of:
cutting a portion of the inorganically filled sheet into a sidewall blank having two straight ends;
convoluting the sidewall blank by overlapping the two straight ends of the sidewall blank to form a sidewall of a cup;
cutting a portion of the inorganically filled sheet into a bottom portion blank;
configuring the bottom portion blank into a bottom portion of a cup; and
assembling the convoluted sidewall and bottom portion together in order to form a two-piece cup.
242. A method for manufacturing an article as defined in claim 193, wherein the fashioning step comprises convoluting a portion of the sheet into the desired shape of the article of manufacture.
243. A method for manufacturing an article as defined in claim 193, further comprising the step of winding continuous fibers around the article.
244. A method for manufacturing an article as defined in claim 193, wherein the fashioning step comprises spiral winding at least a portion of the sheet into the desired shape of the article.
245. A method for manufacturing an article as defined in claim 193, wherein the fashioning step comprises pressing a portion of the sheet into the desired shape of the

article.

246. A method for ...cturing an article as defined in claim 193, wherein the fashioning step co... forming a pouch from at least a portion of the inorganically filled sheet.

247. A method for ...cturing an article as defined in claim 246, further comprising the step of seamir... rtion of the pouch.

248. A method for ...cturing an article as defined in claim 193, wherein the fashioning step yi... n article of manufacture comprising a container with a liner.

249. A method for ...cturing an article of manufacture comprising the steps of:
mixing together wa... n aggregate material, a fibrous material, and an organic binder selected from the ... consisting of cellulose-based binders, starch-based binders, protein-based binc... olysaccharide gums, and mixtures of the foregoing, the mixing step yielding an i... nically filled moldable mixture in which the organic binder is substantially solv... or gelled in the water;
forming the inorga... y filled moldable mixture into an inorganically filled sheet without significa... ering of the mixture;
evaporating a subs... l portion of the water from the inorganically filled sheet in order to substanti... ry the organic binder in less than about 10 minutes after forming the sheet, thereby ...ng the aggregate material and fibrous material within the inorganically fill... t; and
fashioning at leas... rtion of the inorganically filled sheet into a desired shape of the article of ma... ce.

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TITLE: Methods for ufacturing molded sheets having a high starch content

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CLAIMS:

What is claimed an ired to be secured by United States Letters Patent is:
1. A method for ma turing a starch-bound sheet comprising the steps of:
(a) mixing togethe ter, substantially ungelatinized starch granules, a cellulosic ether, a fibrous m rial, and optionally an inorganic aggregate filler to form a moldable mixture;
(b) forming the mo e mixture into an initial green sheet by passing the mixture between at least o t of forming rollers having a temperature such that at least a portion of the cel sic ether forms a skin on outer surfaces of the initial green sheet such that the initi green sheet does not substantially adhere to the forming rollers upon gelatinizatio the starch granules;
(c) passing the in l green sheet between at least one set of rollers having a temperature such t t least a portion of the starch granules become substantially gelatinized in ord form an intermediate green sheet; and
(d) heating the in rm diate green sheet in order to remove a substantial portion of the water from the int diate green sheet so as to form a substantially hardened sheet having a binding m including substantially dried starch and cellulosic ether.
2. A method as def in claim 1, wherein steps (c) and (d) are performed by successive sets of rollers hav increasing temperatures from one set of rollers to a next set of rollers.
3. A method as def in claim 1, wherein steps (c) and (d) are performed by successive sets of rollers ha substantially the same temperature from one set of rollers to a next set of roller
4. A method for ma fa turing a starch-bound sheet comprising the steps of:
(a) mixing togethe wa r, substantially ungelatinized starch granules, a cellulosic ether, a fibrous m l, and optionally an inorganic aggregate filler to form a moldable mixture;
(b) forming the mo e mixture into an initial green sheet by passing the mixture between at least on set of forming rollers having a temperature such that at least a portion of the cel sic ether is caused to substantially thermally precipitate on outer surfaces of the in l green sheet in order that the initial green sheet does not substantially adhe the forming rollers upon gelatinization of the starch granules; and
(c) passing the in ia green sheet between at least one set of heated rollers having a temperature such t least a portion of the starch granules become substantially gelatinized and in to remove a substantial portion of the water from the initial green sheet so as form a substantially hardened sheet having a binding matrix including substanti ly dried starch and cellulosic ether.
5. A method as defi in claim 1, wherein the cellulosic ether has a thermal precipitation temp re and wherein the forming rollers of step (b) have a temperature that is at least h as the thermal precipitation temperature of the cellulosic ether.

6. A method as def … in claim 5, wherein the starch granules have a gelation temperature and wh… the forming rollers of step (b) have a temperature such that the starch granules wi… the moldable mixture remain substantially ungelatinized until step (c).

7. A method as def… in claim 6, wherein the forming rollers utilized in step (b) have a temperature that … less than the gelation temperature of the starch granules.

8. A method as def… in claim 1, wherein the starch granules have a gelation temperature and wh… the forming rollers of step (b) have a temperature such that at least a portion of … starch granules within the moldable mixture become partially gelatinized.

9. A method as def… in claim 1, wherein the starch granules have a concentration in a range from about … about 90% by weight of total solids in the moldable mixture.

10. A method as de… in claim 1, wherein the starch granules have a concentration in a range from about … about 80% by weight of total solids in the moldable mixture.

11. A method as de… in claim 1, wherein the starch granules have a concentration in a range from about … about 70% by weight of total solids in the moldable mixture.

12. A method as de… in claim 1, wherein the starch granules comprise potato starch.

13. A method as de… in claim 1, wherein the starch granules comprise corn starch.

14. A method as de… in claim 1, wherein the starch granules comprise waxy corn starch.

15. A method as d… in claim 1, wherein the cellulosic ether has a concentration in a range from about … about 10% by weight of total solids in the moldable mixture.

16. A method as de… in claim 1, wherein the cellulosic ether has a concentration in a range from about … about 5% by weight of total solids in the moldable mixture.

17. A method as de… in claim 1, wherein the cellulosic ether has a concentration in a range from about … about 4% by weight of total solids in the moldable mixture.

18. A method as de… in claim 1, wherein the cellulosic ether is selected from the group consisting … ethylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellu… methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropyl… lose, and mixtures or derivatives thereof.

19. A method as d… in claim 1, wherein the inorganic aggregate filler has a concentration in … from about 0% to about 90% by weight of total solids in the moldable mixture.

20. A method as d… in claim 1, wherein the inorganic aggregate filler has a concentration in … from about 20% to about 80% by weight of total solids in the moldable mixture.

21. A method as de… in claim 1, wherein the inorganic aggregate filler has a concentration in … from about 30% to about 70% by weight of total solids in the moldable mixture.

22. A method as d… in claim 1, wherein the inorganic aggregate filler is selected from the group co… of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sand… limestone, and mixtures thereof.

23. A method as d… in claim 1, wherein the inorganic aggregate filler comprises individual particl… are size optimized in order to achieve a predetermined natural packing density.

24. A method as de… in claim 23, wherein the natural packing density of the inorganic aggregate filler i… ater than about 0.65.

25. A method as de… in claim 1, wherein the inorganic aggregate filler is selected from the group co… of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, pumice, … tures thereof.

26. A method as d… in claim 1, wherein the fibrous material has a concentration in a range from about … about 40% by weight of total solids in the moldable mixture.

27. A method as d… in claim 1, wherein the fibrous material has a concentration in a range from about … about 30% by weight of total solids in the moldable mixture.

28. A method as de… in claim 1, wherein the fibrous material has a concentration in a range from about … about 20% by weight of total solids in the moldable mixture.

29. A method as de… in claim 1, wherein the fibrous material comprises organic fibers selected from the … consisting of hemp fibers, cotton fibers, bagasse fibers, abaca … pine fibers, southern hardwood fibers, and mixtures thereof.

30. A method as d… in claim 1, wherein the fibrous material includes inorganic fibers selected f… group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, me… bers, and mixtures thereof.

31. A method as d… in claim 1, wherein the fibrous material includes individual fibers having an a… ratio of at least about 10:1.

32. A method as de… in claim 1, wherein the fibrous material includes individual fibers having an … ratio of at least about 100:1.

33. A method as d… in claim 1, wherein the moldable mixture further includes a protein-based bin… ected from the group consisting of prolamine, collagen, gelatin, glue, casein, and … es or derivatives thereof.

34. A method as d… in claim 1, wherein the moldable mixture further includes a polysaccharide se… from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar … ust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives there…

35. A method as d… in claim 1, wherein the moldable mixture further includes a

synthetic organic
polyethylene glyc
polyacrylic acid
polyacrylimides,
derivatives there
36. A method as d
than about 2 kPa.
37. A method as d
than about 100 kP
38. A method as d
temperature and t
gelation temperat
temperature of th
39. A method as d
about 5% to about
40. A method as d
about 10% to abou
41. A method as d
about 20% to abou
42. A method as d
plasticizer.
43. A method as d
substantially har
44. A method as d
45. A method as d
thickness up to a
46. A method as d
thickness less th
47. A method as d
thickness less th
48. A method as d
thickness less th
49. A method as d
thickness less th
50. A method as d
material includes
sheet.
51. A method as d
material includes
within the sheet.
52. A method as d
material includes
within the sheet.
53. A method as d
strength to densi
MPa.cm.sup.3 /g.
54. A method as d
strength to densi
MPa.cm.sup.3 /g.
55. A method as d
strength in a ran
56. A method as d
strength in a ran
57. A method as d
greater than abou
58. A method as d
greater than abou
59. A method as d
being elongated i
60. A method as d
degradable.
61. A method as d
substantially har
62. A method as d
substantially har
63. A method as d
substantially har
64. A method as d
the substantially
65. A method as d
additional sheet
66. A method as d
the substantially
67. A method as d

selected from the group consisting of polyvinyl pyrrolidone, yvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, olyvinylacrylic acids, polyvinylacry ic acid salts, ic acid, ethylene oxide polymers, latex, and mixtures or

in claim 1, wherein the moldable mixture has yield stress greater

in claim 1, wherein the moldable mixture has yield stress greater

in claim 1, wherein the starch granules have a gelation loric ether has a thermal precipitation temperature, wherein the the starch granules is greater than the thermal precipitation losic ether.

in claim 1, wherein the water has a concentration in a range from weight of the moldable mixture.

in claim 1, wherein the water has a concentration in a range from y weight of the moldable mixture.

in claim 1, wherein the water has a concentration in a range from y weight of the moldable mixture.

in claim 1, wherein the moldable mixture further includes a

in claim 1, further including the step of treating the sheet with glycerin.

in claim 43, wherein the glycerin is mixed with water.

in claim 1, wherein the substantially hardened sheet has a cm.

in claim 1, wherein the substantially hardened sheet has a 1 cm.

in claim 1, wherein the substantially hardened sheet has a 5 mm.

in claim 1, wherein the substantially hardened sheet has a 3 mm.

in claim 1, wherein the substantially hardened sheet has a 1 mm.

in claim 1, wherein the method yields sheets wherein the fibrous dual fibers having a substantially random orientation within the

in claim 1, wherein the method yields sheets wherein the fibrous dual fibers having a substantially unidirectional orientation

in claim 1, wherein the method yields sheets wherein the fibrous dual fibers having a substantially bidirectional orientation

in claim 1, wherein the method yields a sheet having a tensile in a range from about 2 MPa.cm.sup.3 /g to about 500

in claim 1, wherein the method yields a sheet having a tensile in a range from about 5 MPa.cm.sup.3 /g to about 150

in claim 1, wherein the method yields a sheet having a tensile about 0.05 MPa to about 100 MPa.

in claim 1, wherein the method yields a sheet having a tensile about 5 MPa to about 80 MPa.

in claim 1, wherein the method yields a sheet having a density m.sup.3.

in claim 1, wherein the method yields a sheet having a density /cm.sup.3.

in claim 1, wherein the method yields a sheet that is capable of ge from about 0.5% to about 12% without completely fracturing.

in claim 1, wherein the method yields a sheet that is water

in claim 1, further including the step of corrugating the sheet.

in claim 1, further including the step of creping the sheet.

in claim 1, further including the step of parchmenting the sheet.

in claim 1, further including the step of applying a coating to ed sheet.

in claim 1, further including the step of laminating at least one substantially hardened sheet.

in claim 1, further including the step of applying an indicia to ed sheet.

in claim 1, further including the step of forming a hinge in the

substantially har ne hee
68. A method as d in aim 1, further including the step of forming a perforation
in the substantia den sheet.
69. A method as d in aim 1, further including the step of fashioning the
substantially har nee into a container.
70. A method as de in claim 1, further including the step of winding the
substantially har hee onto a spool.
71. A method as d fi in aim 1, further including the step of cutting the
substantially har ne hee into smaller sheet segments.
72. A method as d in in laim 1, further including the step of heating the
substantially har hee in order to thermoform it into a desired shape.
73. A method as de in aim 1, further including the step of remoistening the
substantially har neer.
74. A method as d in aim 1, further including the step of spiral winding the
substantially har neet into a desired shape.
75. A method for tur a starch-bound sheet comprising the steps of:
(a) mixing together r, bstantially ungelatinized starch granules having a gelation
temperature, a cellul c er having a thermal precipitation temperature, a fibrous
material, and opt na an inorganic aggregate filler to form a moldable mixture;
(b) forming the m da mi ure into an initial green sheet by passing the mixture
between at least of orming rollers having a temperature at or above the thermal
precipitation tem e of the cellulosic ether such that at least a portion of the
cellulosic ether ski on outer surfaces of the initial green sheet and such that
the initial green doe not substantially adhere to the forming rollers upon
gelatinization of arch granules;
(c) passing the init gre sheet between at least one set of rollers having a
temperature greater t th gelation temperature of the starch granules such that at
least a portion of th tar granules become substantially gelatinized in order to form
an intermediate green eet; and
(d) heating the i er iat green sheet in order to remove a substantial portion of the
water from the int ate green sheet so as to form a substantially hardened sheet
having a binding inc ding substantially dried starch and cellulosic ether.
76. A method for turing a starch-bound sheet comprising the steps of:
(a) mixing togeth r, bstantially ungelatinized starch granules having a gelation
temperature, a cel c er having a thermal precipitation temperature, a fibrous
material, and optiona an norganic aggregate filler to form a moldable mixture having
a yield stress greate han bout 2 kPa, the starch granules having a concentration in a
range from about 5 t bou 90% by weight of total solids within the moldable mixture,
the cellulosic et er ing concentration in a range from about 0.5 to about 10% by
weight of solids w the oldable mixture, the fibers having a concentration in a
range from about 5 bou 40% by weight of total solids within the moldable mixture,
the optional inor ggr ate filler having a concentration in a range from about 0%
to about 90% by w f t al solids within the moldable mixture;
(b) forming the mo mi ure into an initial green sheet by passing the mixture
between at least one of orming rollers having a temperature at or above the thermal
precipitation tempera e c. the cellulosic ether such that at least a portion of the
cellulosic ether form sk on outer surfaces of the initial green sheet and such that
the initial green she doe not substantially adhere to the forming rollers upon
gelatinization of arch granules;
(c) passing the in gre sheet between at least one set of rollers having a
temperature great th gelation temperature of the starch granules such that at
least a portion o tar granules become substantially gelatinized in order to form
an intermediate gr eet and
(d) heating the in iat green sheet in order to remove a substantial portion of the
water from the interm ate een sheet so as to form a substantially hardened sheet
having a binding matr inc ding substantially dried starch and cellulosic ether.
77. A method for tur g a starch-bound sheet comprising the steps of:
(a) mixing togeth r, bstantially ungelatinized starch granules, a cellulosic
ether, a fibrous , d optionally an inorganic aggregate filler to form a
moldable mixture;
(b) forming the m mi ure into the starch-bound sheet by passing the mixture
between at least of eated forming rollers having a temperature in order that at
least a portion of ell osic ether substantially thermally precipitates on outer
surfaces of the she ch the sheet does not substantially adhere to the forming
rollers upon gelatini ion the starch granules and in order to substantially
gelatinize at leas rti of the starch granules and remove a substantial portion of
the water from th by vaporation so as to form the starch-bound sheet having a
binding matrix inc su tantially dried starch and cellulosic ether.
78. A method as de in aim 1, further including the step of fashioning the
substantially hard hee into a desired shape of an article of manufacture.
79. A method as d in aim 1, wherein the moldable mixture further includes a
cross-linking admi
80. A method as de in im 79, wherein the cross-linking admixture is selected from
the group consisting dia hydes, methylureas, and melamine formaldehyde resins.

81. A method as de... in claim 1, wherein the inorganic aggregate filler is selected from the group con... g o... ock, glass beads, aerogels, xerogels, fly ..., fumed silica, fused sili... bub... alumina, kaoline, microspheres, calcium ...minate, xonotlite, lightwe... xpa... ed clays, hydrated hydraulic cement parti...es, waste concrete products, ... lated rock, silica gel, calcium silicate gel, and aluminum silicate gel.

82. A method as de... in claim 1, wherein the inorganic aggregate filler is selected from the group con... ; o... metal balls, filings, pellets, powders, and mixtures thereof.

83. A method as de... in claim 1, wherein the moldable mixture further includes an organic aggregate ... ed f... n the group consisting of seagel, synthetic clay, cork, seeds, lightweight ... ers, ... gar materials, gelatins, and mixtures thereof.

84. A method as de... in claim 1, further including the step of incorporating interstitial voids ... n t... binding matrix of the substantially hardened sheet.

85. A method as de... in claim 1, wherein step (b) further includes extruding the moldable mixture t... a ...ie prior to passing the mixture between the forming rollers.

86. A method as de... in claim 1, wherein the substantially ungelatinized starch granules comprise ... mo... different starches having varying gelation temperatures.

87. A method as de... in claim 1, further including the step of compacting the substantially hard... ...et ...y passing the sheet between at least one pair of compaction rollers.

88. A method as de... in claim 1, further including the step of passing the substantially hard... ...eet between at least one pair of calendering rollers.

89. A method as de... in claim 1, further including the step of passing the substantially hard... ...heet between at least one pair of finishing rollers to impart a desired surface fi...

90. A method as de... in claim 64, wherein the coating is applied by a process selected from the group con... ...g of blade coating, puddle coating, air-knife coating, printing coating, dahlgren ... ...g, ...vure coating, and powder coating.

91. A method as de... in claim 64, wherein the coating is selected from the group consisting of edib... ..., ...amine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacryl... ...lides, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyure... polyethylene, polylactic acid, polyhydroxybutyrat... oxyvalerate copolymers, latex, starches, soybean protein, soybean oil, cellulosic et... synthetic polymers, waxes, elastomers, sodium silicates, calcium carbonate, aluminu... ..., silicone oxide, kaoline clay, ceramic, and mixtures thereof.

92. A method as de... in claim 65, wherein the at least one additional sheet is selected from the ... ...ting of starch-bound sheets, organic polymer sheets, metal foil sheets, ionom... ...ts, elastomeric sheets, plastic sheets, fibrous sheets, mats, paper sheets, cell... ...sheets, nylon sheets, wax sheets, hydraulically settable sheets, highly inorganical... ...ed ...eets, metalized film sheets, and combinations of the foregoing.

93. A method as de... in claim 65, wherein the at least one additional sheet is laminated to the ... ti...ally hardened sheet by a process selected from the group consisting of wet- ... ...ting, dry-bond laminating, thermal laminating, and pressure laminating.

94. A method as de... ...claim 1, wherein steps (b)-(d) occur substantially simultaneously.

L5: Entry 6 of 46 File: USPT Nov 3, 1998

US-PAT-NO: 5830548
DOCUMENT-IDENTIFIER: US 5830548 A

TITLE: Articles of manufacture and methods for manufacturing laminate structures including inorganically filled sheets

DATE-ISSUED: November 3, 1998

INVENTOR-INFORMATION:

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CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:

1. An article of manufacture having a laminate structure comprising an inorganically filled sheet and at least one other sheet laminated to the inorganically filled sheet, the inorganically filled sheet including an organic binder selected from the group consisting of polysaccharides, proteins, water soluble polymers, and mixtures and derivatives thereof, a fibrous material, and an inorganic aggregate filler in an amount in a range from about 70% to about 90% by weight of solids in the inorganically filled sheet, said inorganically filled sheet having a thickness less than about 1 cm.

2. An article of manufacture as defined in claim 1, wherein the inorganically filled sheet has physical characteristics which differ from the physical characteristics of the at least one other sheet.

3. An article of manufacture as defined in claim 1, wherein the inorganically filled sheet has chemical characteristics which differ from the chemical characteristics of the at least one other sheet.

4. An article of manufacture as defined in claim 1, wherein the inorganically filled sheet and the at least one other sheet have physical and chemical properties which combine to produce a synergistic result in the laminate structure.

5. An article of manufacture as defined in claim 1, wherein the at least one other sheet creates a barrier to fluid within the laminate structure.

6. An article of manufacture as defined in claim 1, wherein the laminate structure is substantially impermeable to gas.

7. An article of manufacture as defined in claim 1, wherein the laminate structure provides a barrier to electromagnetic radiation.

8. An article of manufacture as defined in claim 1, wherein the at least one other sheet comprises a metallic foil.

9. An article of manufacture as defined in claim 1, wherein the laminate structure provides a fire retardant barrier.

10. An article of manufacture as defined in claim 9, wherein the fire retardant barrier is essentially non-combustible.

11. An article of manufacture as defined in claim 1, wherein the organic binder comprises a cellulose-based material.

12. An article of manufacture as defined in claim 11, wherein the cellulose-based material is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethyl-propylcellulose, and mixtures or derivatives thereof.

13. An article of manufacture as defined in claim 1, wherein the organic binder comprises a starch-based material.

14. An article of manufacture as defined in claim 13, wherein the starch-based material is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.

15. An article of manufacture as defined in claim 1, wherein the organic binder comprises a polysaccharide material selected from the group consisting of alginic acid, phycocolloids, agar, starch, guar gum, locust bean gum, gum caraya, gum tragacanth, and mixtures or derivatives thereof.
16. An article of manufacture as defined in claim 1, wherein the organic binder comprises a protein-based material selected from the group consisting of prolamine, collagen, casein, and mixtures or derivatives thereof.
17. An article of manufacture as defined in claim 1, wherein the organic binder further comprises a synthetic organic material selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, ethylene oxide polymers, polylactic acid, synthetic clay, latex, and mixtures or derivatives thereof.
18. An article of manufacture as defined in claim 1, wherein the organic binder has a concentration in a range from about 2% to about 40% by weight of total solids in the inorganically field sheet.
19. An article of manufacture as defined in claim 1, wherein the organic binder has a concentration in a range from about 5% to about 30% by weight of total solids in the inorganically filled sheet.
20. An article of manufacture as defined in claim 1, wherein the inorganic aggregate filler is selected from the group consisting of perlite, vermiculite, sand, gravel, rock, limestone, sandstone, glass beads, aerogel, xerogels, seagel, mica, clay, synthetic clay, alumina, fly ash, fumed silica, fused silica, tabular alumina, kaolin, microspheres, hollow glass spheres, porous ceramic spheres, gypsum dihydrate, calcium carbonate, calcium aluminate, cork, fiber glass, lightweight polymers, xonotlite, lightweight expanded clays, hydrated cement particles, unhydrated cement particles, pumice, exfoliated rock, and mixtures or derivatives thereof.
21. An article of manufacture as defined in claim 1, wherein the inorganic aggregate filler has a concentration in a range from about 30% to about 80% by weight of total solids in the inorganically filled sheet.
22. An article of manufacture as defined in claim 1, wherein the inorganic aggregate filler has a concentration in a range from about 40% to about 70% by weight of total solids in the inorganically filled sheet.
23. An article of manufacture as defined in claim 1, wherein the inorganically filled sheet further comprises an organic aggregate.
24. An article of manufacture as defined in claim 23, wherein the organic aggregate is selected from the group consisting of seeds, starches, gelatins, agar materials, and mixtures or derivatives thereof.
25. An article of manufacture as defined in claim 23, wherein the organic aggregate is a light-weight polyethylene having a concentration between about 3% to about 6% by weight of total solids in the inorganically filled sheet.
26. An article of manufacture as defined in claim 1, wherein the fibrous material comprises organic fibers.
27. An article of manufacture as defined in claim 26, wherein the organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, southern hardwood fibers, and mixtures or derivatives thereof.
28. An article of manufacture as defined in claim 1, wherein the fibrous material comprises inorganic fibers.
29. An article of manufacture as defined in claim 28, wherein the inorganic fibers are selected from the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers and mixtures or derivatives thereof.
30. An article of manufacture as defined in claim 1, wherein the fibrous material includes individual fibers having an average aspect ratio of at least about 10:1.
31. An article of manufacture as defined in claim 1, wherein the fibrous material includes individual fibers having an average aspect ratio of at least about 100:1.
32. An article of manufacture as defined in claim 1, wherein the fibrous material includes individual fibers having an average aspect ratio of at least about 200:1.
33. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 0.2% to about 60% by weight of total solids in the inorganically filled sheet.
34. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 1% to about 40% by weight of total solids in the inorganically filled sheet.
35. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 5% to about 20% by weight of total solids in the inorganically filled sheet.
36. An article of manufacture as defined in claim 1, wherein the fibrous material comprises a mixture of different fibers having varying strengths and flexibilities.
37. An article of manufacture as defined in claim 1, wherein the fibrous material increases the flexibility of the inorganically filled sheet.
38. An article of manufacture as defined in claim 1, wherein the fibrous material comprises individual fibers which have a substantially random orientation within the inorganically filled sheet.
39. An article of manufacture as defined in claim 1, wherein the fibrous material

comprises individual [illegible] which have a substantially unidirectional orientation within the inorganically fi[illegible]
40. An article of ma[illegible] as defined in claim 1, wherein the fibrous material comprises individual [illegible]ers which have a substantially bidirectional orientation within the inorganically fi[illegible]
41. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet is water degra[illegible]
42. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet is readily deg[illegible] into environmentally neutral components.
43. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet has a tensile [illegible] in a range from about 0.05 MPa to about 70 MPa.
44. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet has a tensile s[illegible]gth in a range from about 5 MPa to about 40 MPa.
45. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet has a tensile [illegible]ngth to density ratio in a range from about [illegible] MPa-cm.sup.3 /g to about 200 MPa-cm.sup.3/g.
46. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet has a tensile [illegible]gth to density ratio in a range from about 3 MPa-cm.sup.3 /g to about 50 Mpa-cm.sup.[illegible].
47. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet has a maximum [illegible] of about 2 g/cm.sup.3.
48. An article of man[illegible] as defined in claim 1, wherein the inorganically filled sheet has a density i[illegible]e from about 0.4 g/cm.sup.3 to about 1.5 g/cm.sup.3.
49. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet can elongate i[illegible] from about 0.5% to about 8% without completely fracturing.
50. An article of ma[illegible] as defined in claim 1, wherein at least one of the inorganically filled [illegible] the one other sheet is corrugated.
51. An article of ma[illegible] as defined in claim 1, wherein at least one of the inorganically filled [illegible] the one other sheet is creped.
52. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet has been compa[illegible].
53. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet has been calen[illegible].
54. An article of ma[illegible] as defined in claim 1, further comprising a coating on at least a portion of th[illegible]nically filled sheet.
55. An article of ma[illegible] as defined in claim 1, further comprising an adhesive between the inorganic[illegible]led sheet and the one other sheet.
56. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet has been resin[illegible]ted.
57. An article of ma[illegible] as defined in claim 1, wherein the laminate structure further comprises a [illegible]thin the laminate structure, wherein the cavity is formed by a structural element [illegible]he cavity.
58. An article of ma[illegible] as defined in claim 57, wherein the cavity is formed between the inorgani[illegible]led sheet and the one other sheet.
59. An article of ma[illegible] as defined in claim 57, wherein the cavity comprises a material selected fr[illegible]oup consisting of a fluid, a gas, a granular particulate material, a solid mat[illegible]nd mixtures thereof.
60. An article of ma[illegible] as defined in claim 1, wherein the laminate structure further comprises:
means for adhering th[illegible]nically filled sheet and the one other sheet together to form the laminate st[illegible]
61. An article of ma[illegible] as defined in claim 60, wherein the one other sheet is wet bond laminated to th[illegible]ically filled sheet.
62. An article of ma[illegible] as defined in claim 60, wherein the one other sheet is dry bond laminated to th[illegible]ically filled sheet.
63. An article of ma[illegible] as defined in claim 60, wherein the one other sheet is thermal bond laminate[illegible] inorganically filled sheet.
64. An article of ma[illegible] as defined in claim 60, wherein the one other sheet is cementitio[illegible] bond la[illegible]d to the inorganically filled sheet.
65. An article of ma[illegible] as defined in claim 1, wherein at least one of the inorganically filled[illegible] the other sheet is porous.
66. An article of m[illegible] as defined in claim 1, wherein at least one of the inorganically filled[illegible] the other sheet is impervious.
67. An article of m[illegible] as defined in claim 1, wherein the inorganically filled sheet has [illegible] thickness[illegible]n about 3 mm.
68. An article of ma[illegible] as defined in claim 1, wherein the laminate structure is mass prod[illegible]ible.
69. An article of ma[illegible] as defined in claim 1, wherein the inorganically filled sheet inc[illegible]es fine[illegible]d air voids.
70. An article of m[illegible] as defined in claim 1, wherein the laminate structure is fashioned into a co[illegible]
71. An article of m[illegible] as defined in claim 1, wherein the laminate structure has a tubular sh[illegible]pe.
72. An article of m[illegible] as defined in claim 1, wherein the laminate structure is

water deg :able.
73. An ar le of mar as defined in claim 1, wherein the laminate structure includes score cut.
74. An ar le of man as defined in claim 1, wherein the laminate structure includes erforatio
75. An ar le of mar as defined in claim 1, wherein the laminate structure comprises continuo ically filled sheet that has been rolled onto a spool.
76. An ar le of ma as defined in claim 1, wherein the one other sheet is selected m the gr sting of metallic foils, textile fabrics, paper, paperboard, foam, she that fo with increased temperatures, inorganically illed sheets, plastics, d mixture ivatives thereof.
77. An ar le of man as defined in claim 1, wherein the laminate structure is photosens ive.
78. An ar le of man as defined in claim 1, wherein the laminate structure is transluce
79. An ar le of man as defined in claim 1, wherein the laminate structure is transpare
80. An ar le of ma as defined in claim 1, wherein the laminate tructure is water-pro
81. An ar le of ma as defined in claim 1, wherein the laminate structure is oil resis .
82. An ar le of man as defined in claim 1, wherein the laminate structure is a barrier t lavor.
83. An ar le of man as defined in claim 1, wherein the laminate structure is a barrier to dor.
84. An ar le of mar as defined in claim 1, wherein the laminate structure is a barrier t icrowave
85. An ar le of ma u as defined in claim 1, wherein the laminate structure is a barrier t lectricit
86. An ar le of man u as defined in claim 1, wherein the laminate structure is an electrica nsulator.
87. An ar le of man tu as defined in claim 1, wherein the laminate structure is an electrica onductor.
88. An ar e of man as defined in claim 1, wherein the laminate structure is a barrier t ound.
89. An ar le of man as defined in claim 1, wherein the laminate structure is a thermal i ation b .
90. An ar le of ma u as defined in claim 1, wherein the laminate structure is an abrasion istant ba .
91. An ar e of man tu as defined in claim 1, wherein the laminate structure is a barrier t ological nt
92. An ar e of man tu as defined in claim 1, wherein at least one of the inorganic filled t the one other sheet comprise a cellular structure.
93. An ar e of man u as defined in claim 1, wherein the one other sheet is selected the gr sting of a polyolefin, ethylvinyl alcohol, a polyester, a co-polyme d polye a lyamide, aluminum foil, caulking polymer layers, polyethyle tereph e, lyurethane elastomers, polyethylene, polyvinylchloride film, pol ylene th te, and mixtures or derivatives thereof.
94. An ar e of man tu as defined in claim 1, wherein the laminate structure is coated wi conduct in so that the laminate structure has an anti-static quality.
95. An ar e of man tu as defined in claim 1, wherein the laminate structure is glossy.
96. An ar e of man tu having a laminate structure produced by the process comprisin e steps
providing inorgani lled sheet including an organic binder selected from the group cons ing of cc rides, proteins, water soluble polymers, and mixtures and derivative hereof, orc material, and an inorganic aggregate filler in an amount in a rang om abou to bout 90% by weight of solids in the inorganically filled sheet, sa norganic f ed sheet having a thickness less than about 1 cm;
providing least on he sheet to be laminated to the inorganically filled sheet;
applying dhesive ne f the inorganically filled sheet or the at least one other sheet;
placing t norganic f ed sheet and the at least one other sheet together; and
pressing inorgani y lled sheet and the at least one other sheet together.
97. An ar e of ma tu as defined in claim 96, further including the step of applying h to the gar ally filled sheet and the at least one other heet subsequen the pr g p.
98. An ar e of man tu as defined in claim 96, further including the step of corrugati t least of e inorganically filled sheet or the one other sheet prior to placin e inorga ll illed sheet and the one other sheet together.
99. An ar e of man tu as defined in claim 96, further including the step of coating a ast one he organically filled sheet or the one other sheet prior to placing t norgani f ed sheet and the one other sheet together.
100. An a le of m t as defined in claim 96, further including the step of

fashioning the laminate structure into a container.
101. An article of manufacture as defined in claim 96, further including the step of perforating the laminate structure to facilitate bending of the laminate structure.
102. An article of manufacture having a laminate structure produced by the process comprising the steps:
providing an inorganically filled sheet wound on a spool and including an organic binder selected from the group consisting of polysaccharides, proteins, water soluble polymers, and mixtures and derivatives thereof, an inorganic aggregate filler in an amount in a range from about 20% about 90% by weight of solids in the inorganically filled sheet, and a substantial quantity of starch, said inorganically filled sheet having a thickness less than about 1 cm;
providing at least one other sheet to be laminated to the inorganically filled sheet;
removing at least a portion of the inorganically filled sheet from the spool;
pressing the portion of the inorganically filled sheet and the at least one other sheet together; and
heating the inorganically filled sheet and the at least one other sheet together in order to form a thermoformable laminate therebetween.
103. An article of manufacture as defined in claim 102, further including the step of fashioning the laminate structure into a container.
104. An article of manufacture as defined in claim 102, further including the step of perforating the laminate structure to facilitate bending of the laminate structure.
105. An article of manufacture as defined in claim 102, further including the step corrugating at least a portion of the inorganically filled sheet or the one other sheet prior to pressing the portion of the inorganically filled sheet and the one other sheet together.
106. An article of manufacture as defined in claim 102, further including the step of coating at least one portion of the inorganically filled sheet or the one other sheet prior to pressing the portion of the inorganically filled sheet and the one other sheet together.
107. An article of manufacture having a laminate structure comprising:
(a) a starch-bound sheet including:
(i) a binding matrix including starch and a cellulosic ether, the starch having a concentration in a range from about 5% to about 90% by weight of total solids in the starch-bound sheet, the cellulosic ether having a concentration in a range from about 0.5% to about 10% by weight of total solids in the starch-bound sheet;
(ii) a fibrous material substantially homogeneously dispersed throughout the binding matrix and having a concentration of at least 3% by weight of total solids in the starch-bound sheet; and
(iii) an inorganic aggregate filler having a concentration in a range from about 0% to about 90% by weight of total solids in the starch-bound sheet;
wherein the starch-bound sheet has a thickness less than about 1 cm and a density greater than about 0.5 g/cm; and
(b) at least one other sheet laminated to the starch-bound sheet.
108. An article of manufacture as defined in the claim 107, wherein the starch has a concentration in a range from about 15% to about 75% by weight of total solids in the starch-bound sheet.
109. An article of manufacture as defined in claim 107, wherein the starch has a concentration in a range from about 30% to about 70% by weight of total solids in the starch-bound sheet.
110. An article of manufacture as defined in claim 107, wherein the starch comprises unmodified potato starch.
111. An article of manufacture as defined in claim 107, wherein the starch comprises unmodified corn starch.
112. An article of manufacture as defined in claim 107, wherein the starch comprises unmodified waxy corn starch.
113. An article of manufacture as defined in claim 107, wherein the cellulosic ether has a concentration in a range from about 1% to about 5% by weight of total solids in the starch-bound sheet.
114. An article of manufacture as defined in claim 107, wherein the cellulosic ether has a concentration in a range from about 2% to about 4% by weight of total solids in the starch-bound sheet.
115. An article of manufacture as defined in claim 107, wherein the cellulosic ether is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethyl-propylcellulose, and mixtures or derivatives thereof.

116. An article of manufacture as defined in claim 107, wherein the binding matrix further includes a protein-based binder selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
117. An article of manufacture as defined in claim 107, wherein the binding matrix further includes a polysaccharide selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
118. An article of manufacture as defined in claim 107, wherein the binding matrix

further i cludes a syn rganic binder selected from the group consisting of polyvinyl pyrrolidone, ylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacryl acids, pol acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, po vacrylimides actic acid, ethylene oxide polymers, latex, and mixtures or derivativ thereof.

119. An a ticle of manu as defined in claim 107, wherein the inorganic aggregate filler ha a concentrat on i a range from about 20% to about 30% by weight of total solids in the starch-bo nd et.

120. An a ticle of man as defined in claim 107, wherein the inorganic aggregate filler ha a concentra a range from about 30% to about 70% by weight of total solids in the starch-b et.

121. An a ticle of man as defined in claim 107, wherein the inorgan c aggregate filler is elected fro oup consisting of clay, gypsum, calcium carbonate, mica, silica, a mina, sand, sandstone, limestone, and mixtures or derivatives thereof.

122. An a ticle of manu as defined in claim 107, wherein the inorganic aggregate filler comprises indivi l rticles that are size optimized in order to achieve a predeterm ned natural packing density.

123. An a ticle of man as defined in claim 107, wherein the natural particle packing d sity of the ic aggregate filler is at least about 0.65.

124. An a ticle of manu as defined in claim 107, wherein the inorganic aggregate filler co prises a ligh lig aggregate selected from the group consisting of perlite, vermiculi , hollow gla s sp res, porous ceramic spheres, pumice, and mixtures thereof.

125. An a ticle of manu e as defined in claim 107, wherein the fibrous material has a concent ation in a ra e f m about 5% to about 30% by weight of total solids in the starch-bo nd sheet.

126. An a ticle of manu as defined in claim 107, wherein the fibrous material has a concent ation in a ra e f m about 7% to about 20% by weight of total solids in the starch-bo nd sheet.

127. An a ticle of manu as defined in claim 107, wherein the fibrous material comprises organic fibe el ted from the group consisting of hemp fibers, cotton fibers, b gasse fibers, ac fibers, flax, southern pine fibers, southern hardwood fibers, a mixtures th eof

128. An a ticle of manu as defined in claim 107, wherein the fibrous material comprises inorganic fib s ected from the group consisting of glass fibers, silica fibers, c amic fibers, b fibers, metal fibers, and mixtures thereof.

129. An a ticle of manu as defined in claim 107, wherein the fibrous material includes ndividual fib h ing an average aspect ratio of at least about 10:1.

130. An a ticle of manu as defined in claim 107, wherein the fibrous material includes ndividual fib h ing an average aspect ratio of at least about 100:1.

131. An a ticle of manu as defined in claim 107, wherein the fibrous material includes mixture of d fer t fibers having varying strengths and flexibilities.

132. An a ticle of manu as defined in claim 107, wherein the fibrous material comprises individual fi rs ich have a substantially random orientation within the starch-bo nd sheet.

133. An a ticle of manu as defined in claim 107, wherein the fibrous material comprises individual fi ich have a substantially unidirectional orientation within the starc ound sheet.

134. An a ticle of manu as defined in claim 107, wherein the fibrous material comprises individual fi s ich have a substantially bidirectional orientation within the starc ound sheet.

135. An a ticle of manu as defined in claim 107, wherein the starch-bound sheet has a ten ile strength de ity ratio in a range from about 2 MPa.cndot.cm.sup.3 /g to about 500 Pa.cndot.cm. .3 g.

136. An a ticle of manu as defined in claim 107, wherein the starch-bound sheet has a ten ile strength de ity ratio in a range from about 5 MPa.cndot.cm.sup.3 /g to about 150 Pa.cndot.cm. .3 g.

137. An a ticle of manu as defined in claim 107, wherein the starch-bound sheet has a ten ile strength a nge from about 0.05 MPa to about 100 Mpa.

138. An a ticle of manu as defined in claim 107, wherein the starch-bound sheet has a ten ile strength a nge from about 5 MPa to about 80 MPa.

139. An a ticle of manu as defined in claim 107, wherein the starch-bound sheet has a den ty greater t about 1 g/cm.sup.3.

140. An a ticle of manu as defined in claim 107, wherein the starch-bound sheet has a den ty greater t about 1.5 g/cm.sup.3.

141. An a ticle of manu as defined in claim 107, wherein the starch-bound sheet can elong te in a range bout 0.5% to about 12% without completely fracturing.

142. An a ticle of manu as defined in claim 107, wherein the starch-bound sheet is water deg dable.

143. An a ticle of manu as defined in claim 107, wherein at least one of the starch-bo nd sheet and o er sheet is corrugated.

144. An a ticle of manu as defined in claim 107, wherein at least one of the starch-bo nd sheet and o er sheet is creped.

145. An a ticle of manu as defined in claim 107, wherein at least one of the

starch-bound sheet and the other sheet further includes a coating.

146. An article of manufacture as defined in claim 107, wherein the one other sheet is selected from the group consisting of metallic foils, textile fabrics, paper, paperboard, foam, sheets that form a barrier with increased temperatures, inorganically filled sheets, plastics, and mixtures or derivatives thereof.

L5: Entry 3 of 46 File: USPT Jul 27, 1999

US-PAT-NO: 5928741
DOCUMENT-IDENTIFIER: US 5928741 A

TITLE: Laminated arti[cl]es of manufacture fashioned from sheets having a highly inorganically filled [or]anic polymer matrix

DATE-ISSUED: July 27, 99

INVENTOR-INFORMATION

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US-CL-CURRENT: 428/35.[2] 206/524.3, 206/524.7, 428/152, 428/168, 428/182, 428/36.4, 428/36.6, 428/532, 4[2]8/536

CLAIMS:

What is claimed and d[es]ired to be secured by United States Letters Patent is:
1. An article of manu[fac]ture fashioned from at least a portion of a laminated sheet comprising a first sh[ee]t having an inorganically filled matrix and a second sheet laminated to a side o[f] the first sheet, the organically filled matrix comprising a substantially homogen[eous] mixture of organic binder and inorganic aggregate, the organic binder being selecte[d fr]om the group consisting of polysaccharides, proteins, and mixtures or derivati[ves] thereof, the inorganic aggregate having a concentration in a range from about 40% [to] about 95% by weight of total solids in the matrix, the inorganically filled [ma]trix of the sheet further including an optional fibrous component substantially homoger[eou]sly dispersed throughout the matrix, wherein the matrix has a thickness in a range [fr]om about 0.01 mm to about 1 cm, is sufficiently flexible such that it may be significan[tly] mechanically deformed without complete rupture of the matrix, and degrades after prolo[nged] exposure to water.
2. An article of manu[fac]ture as defined in claim 1, wherein the laminated sheet further includes a coating m[ate]rial on at least a portion of the sheet.
3. An article of ma[nuf]acture as defined in claim 2, wherein the coating material renders the inorganically fi[lled] matrix substantially resistant to penetration by water.
4. An article of manu[fac]ture as defined in claim 2, wherein the coating material renders the inorganically fi[lled] matrix substantially resistant to penetration by grease or oils.

5. An article of manu[fac]ture as defined in claim 2, wherein the coating material renders the article of manuf[act]ure substantially liquid-tight.
6. An article of manu[fac]ture as defined in claim 2, wherein the coating material renders the article of manu[fac]ture substantially pressure-tight.
7. An article of ma[nuf]acture as defined in claim 2, wherein the coating material increases the flexi[bil]ity of the article of manufacture.
8. An article of ma[nuf]acture as defined in claim 2, wherein the coating material is safe for use with food or [bev]erages.
9. An article of manu[fac]ture as defined in claim 2, wherein the coating material is biodegradable.
10. An article of ma[nufa]cture as defined in claim 2, wherein the coating material is selected from the gr[oup] consisting of melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, p[oly]acrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyureth[anes], polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, [gum]s, elastomers, edible oils, and mixtures or derivatives thereof.
11. An article of m[anufa]cture as defined in claim 2, wherein the coating material is selected from the g[rou]p consisting of sodium silicate, calcium carbonate, kaolin, silicon oxide, aluminum oxid[e], ceramic, and mixtures of the foregoing.
12. An artic[le] of ma[nufa]cture as defined in claim 1, wherein the second sheet comprises a laminar coating mat[eri]al on the inorganically filled matrix.
13. An article of m[anufa]cture as defined in claim 12, wherein the second sheet also includes an inorgan[ically] filled matrix.

14. An article of manufacture as defined in claim 12, wherein the second sheet is selected from the group consisting of organic polymer sheets, metal foils, fiber sheets, ceramic sheets, ion exchange resins, elastomeric sheets, plastic sheets, cellophane sheets, nylon sheets, wax sheets, crystallized films, and combinations of the foregoing.

15. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.

16. An article of manufacture as defined in claim 1, wherein the aggregate material is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.

17. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes an organic aggregate selected from the group consisting of seeds, starches, gelatins, and agar materials.

18. An article of manufacture as defined in claim 1, wherein the aggregate material includes an inorganic gel selected from the group consisting of silica gel, aluminum silicate gel, calcium silicate gel, and mixtures thereof.

19. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix of the laminated sheet has a thickness less than about 3 mm.

20. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix of the laminated sheet has a thickness less than about 0.5 mm.

21. An article of manufacture as defined in claim 1, wherein the organic binder and fibrous component having a combined concentration less than about 40% by volume of total solids in the inorganically filled matrix.

22. An article of manufacture as defined in claim 1, wherein the organic binder has a concentration in a range from about 2% to about 30% by volume of total solids in the inorganically filled matrix.

23. An article of manufacture as defined in claim 1, wherein the organic binder comprises a cellulose ether.

24. An article of manufacture as defined in claim 1, wherein the organic binder comprises a starch derivative.

25. An article of manufacture as defined in claim 1, wherein the organic binder comprises a protein derivative.

26. An article of manufacture as defined in claim 1, wherein the organic binder comprises a polysaccharide material selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.

27. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix further includes a synthetic organic polymer selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimide, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures thereof.

28. An article of manufacture as defined in claim 1, wherein the fibrous component has a concentration in a range from about 0.5% to about 5% by volume of total solids in the inorganically filled matrix.

29. An article of manufacture as defined in claim 1, wherein the fibrous component has a concentration in a range from about 5% to about 40% by volume of total solids in the inorganically filled matrix.

30. An article of manufacture as defined in claim 1 wherein the fibrous component includes organic fibers selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, and southern hardwood fibers, and mixtures thereof.

31. An article of manufacture as defined in claim 1, wherein the fibrous component includes organic fibers selectedfrom the group consisting of glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixtures thereof.

32. An article of manufacture as defined in claim 1, wherein the fibrous component includes individual fibers having an aspect ratio greater than about 10:1.

33. An article of manufacture as defined in claim 1, wherein the aggregate material includes a hydraulically settable material.

34. An article of manufacture as defined in claim 33, wherein the hydraulically settable material is selected from the group consisting of hydraulic cement, calcium sulfate hemihydrate, calcium oxide, and mixtures of the foregoing.

35. An article of manufacture as defined in claim 1 wherein the inorganically filled matrix further includes a discontinuous phase of finely dispersed voids.

36. An article of manufacture as defined in claim 1, wherein the fibrous component includes individual fibers having a substantially random orientation within the inorganically filled matrix.

37. An article of manufacture as defined in claim 1, wherein the fibrous component comprises individual fibers which have a substantially unidirectional orientation within the inorganically filled matrix.

38. An article of manufacture as defined in claim 1, wherein the inorganically filled matrix of the laminated sheet can elongate in a range from about 0.5% to about 8% without completely fracturing.

39. An article of manufacture as defined in claim 1, wherein the laminated sheet includes a score or scores defining a fold line.

40. An ar[ticle] of [manu]facture as defined in claim 1, w[herein] the laminated sheet includes a perfora[tion] defi[ning] a fold or tear line.

41. An ar[ticle] of [manu]facture as defined in claim 1, w[herein] the article of manufacture comprises contai[ner].

42. An art[icle] of [manu]facture as defined in claim 1, w[herein] the article of manufacture comprises food o[r] beverage container.

43. An art[icle] of [manu]facture as defined in claim 1, w[herein] the article of manufacture includes a seam.

44. An art[icle] of [manu]facture as defined in claim 1, w[herein] the article of manufacture includes mechanical interlocking devices.

45. An ar[ticle] of [manu]facture as defined in claim 1, w[herein] the article of manufacture comprises a cup.

46. An art[icle] of [manu]facture as defined in claim 1, w[herein] the article of manufacture comprises hinged clam-shell container.

47. An art[icle] of [manu]facture as defined in claim 1, w[herein] the article of manufacture comprises carton.

48. An art[icle] of [manu]facture as defined in claim 1, wherein the article of manufacture comprises milk or juice carton.

49. An art[icle] of [manu]facture as defined in claim 1, w[herein] the article of manufacture comprises box.

50. An art[icle] of [manu]facture as defined in claim 1, w[herein] the article of manufacture comprises envelope.

51. An art[icle] of [manu]facture as defined in claim 1, w[herein] the laminated sheet has been convoluted to form the article of manufacture.

52. An art[icle] of [manu]facture as defined in claim 1, w[herein] the laminated sheet has been spiral wou[nd] to fo[rm] the article of manufacture.

53. An art[icle] of [manu]facture as defined in claim 1, wherein the article of manufacture is selecte[d] from t[he] group consisting of a can, a frozen juice concentrate container, a potato chi[p] contai[ner], an ice cream container, a salt container, a detergent container, a motor oil [con]taine[r], and a mailing tube.

54. An art[icle] of [manu]facture as defined in claim 1, w[herein] the article of manufacture comprises plate.

55. An art[icle] of [manu]facture as defined in claim 1, wherein the article of manufacture comprises lid.

56. An art[icle] of [manu]facture as defined in claim 1, wherein the article of manufacture is a rigid cup.

57. An art[icle] of [manu]facture as defined in claim 1, wherein the article of manufacture comprises pouch.

58. An art[icle] of [manu]facture as defined in claim 1, wherein the inorganically filled matrix is [for]med by removing a substantial quantity of water from an inorganically filled mixture in[clu]ding water, the water-dispersible organic binder, the inorganic aggregate material, and the [aque]ous component.

59. An art[icle] of [manu]facture fashioned from at least a portion of a laminated sheet comprising a first sheet having an inorganically filled matrix and a second sheet laminated thereto, the inorganically filled matrix comprising a substantially homogeneous mixture of organic binder and inorganic aggregate, the organic binder being selected from the group consisting of starch-based materials, cellulose-based materials, polysaccharide gums, proteins, and mixtures or derivatives thereof, the inorganic aggregate having a concentration in a range from about 40% to about 95% by weight of total solids in the matrix, the inorganically filled matrix of the sheet further including fibers substantially homogeneously dispersed throughout the matrix, wherein an inorganically filled material has a thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water.

60. An art[icle] of [manu]facture as defined in claim 59, wherein the inorganically filled matrix is formed by removing a substantial quantity of water from an inorganically filled mixture including the organic binder, the inorganic aggregate material, and the fibers.

61. An art[icle] of [manu]facture as defined in claim 59, wherein the inorganically filled matrix is flexible in that is may be significantly deformed without complete rupture of the matrix.

62. An art[icle] of [manu]facture as defined in claim 59, wherein the second sheet comprises a laminar [backing] material adhered to the inorganically filled matrix.

63. An art[icle] of [manu]facture fashioned from at least a portion of a laminated sheet by bending, [fold]ing, the laminated sheet comprising a first sheet having an inorganically fil[led] matrix and a second sheet lami[nated] thereto, the inorganically filled mat[rix] com[prising] a substantially homogeneous mixture of organic binder and inorganic [aggregate], the organic binder being selected from the group consisting of polysaccha[rides], [protein]s, and mixtures or derivatives thereof, the inorganic aggregate having a [concentration] in a range from about 40% to about 95% by weight of total solids in the mat[rix], the inorganically filled matrix of the sheet further including fibers substantially homo[geneously] dispersed throughout the matrix, wherein the organic binder and the o[rganic] fi[bers] have a combined concentration in a range from about 5% to about 60% by we[ight] of [total] solids in the inorganically filled matrix, the inorganically filled mat[erial] hav[ing a] thickness in a range from about 0.01 mm to about 1 cm.

64. An article of manufacture as defined in claim 63, wherein the inorganically filled matrix is formed by removing a substantial quantity of water from an inorganically filled mixture including the organic binder, the inorganic aggregate material, and the fibers.

65. An article of manufacture as defined in claim 63, wherein the inorganically filled matrix is flexible such that it may be significantly mechanically deformed without complete rupture of the matrix.

66. An article of manufacture as defined in claim 63, wherein the article comprises a container.

67. An article of manufacture fashioned from at least a portion of a laminated sheet comprising a first sheet having an inorganically filled matrix and a second sheet laminated to the first sheet, the inorganically filled matrix comprising a substantially homogenous mixture of organic binder and inorganic aggregate, the organic binder being selected from the group consisting of starch-based materials, cellulose-based materials, polysaccharide gums, proteins, and mixtures or derivatives thereof, the inorganic aggregate having a concentration in a range from about 40% to about 98% by volume of total solids in the matrix, the inorganically filled matrix of the sheet further including an optional fibrous component substantially homogeneously dispersed throughout the matrix, wherein the matrix has a thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water, and is sufficiently flexible such that it may be significantly mechanically deformed without complete rupture of the matrix wherein the second sheet renders the laminated sheet substantially nonporous where the second sheet is laminated to the first sheet.

68. An article of manufacture fashioned from at least a portion of a laminated sheet comprising a first sheet having an inorganically filled matrix and a second sheet laminated thereto, the inorganically filled matrix comprising a substantially homogenous mixture of organic binder and inorganic aggregate, the organic binder being selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof, the inorganic aggregate having a concentration in a range from about 40% to about 98% by volume of total solids in the matrix, the inorganically filled matrix of the sheet further including substantially homogeneously throughout the matrix, wherein the matrix has a thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water.

69. An article of manufacture fashioned from at least a portion of a laminated sheet comprising a first sheet having an inorganically filled second sheet laminated to the first sheet, the inorganically filled matrix comprising a substantially homogenous mixture of organic binder and inorganic aggregate, the organic binder being selected from the group consisting of polysaccharide gums, proteins, cellulose-based materials, nonionic starch-based mixtures or derivatives thereof, the inorganic aggregate having a concentration in a range from about 40% to about 98% by weight of total solids in the matrix, the inorganically filled matrix of the sheet further including a fibrous component substantially homogeneously dispersed throughout the matrix, the matrix having a thickness in a range from about 0.01 mm to about 1 cm.

L5: Entry 2 of 46 File: USPT Feb 29, 2000

US-PAT-NO: 6030673
DOCUMENT-IDENTIFIE 6030673 A

TITLE: Molded sta und containers and other articles having natural and/or synthetic polymer coatings

DATE-ISSUED: Febr 9, 2000

INVENTOR-INFORM.T.

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US-CL-CURRENT: 428 ; 156/78, 206/524.3, 206/524.7, 427/316, 427/399, 428/317.3, 428/317.9, 428/31 28/319.1, 428/319.3, 428/319.7, 428/36.5, 428/913

CLAIMS:

What is claimed an ired to be secured by United States Letters Patent is:

1. An article of cture comprising:
a starch-bound cel matrix formed by gelatinizing a starch-based binder in water and then causing the -based binder to substantially harden by removing a substantial portion of the wa evaporation to thereby form the starch-bound cellular matrix, wherein the starc l cellular matrix includes an outer skin portion having a density and an int rior tion having a density that is significantly lower than the density of the ou n portion, the starch-bound cellular matrix further including optional component ersed therein; and
a coating pplied least a portion of the outer skin portion of the starch-bound cellular m trix s l from the group consisting of edible oils, drying oils, melamine, phenolic r sins, ter resins, epoxy resins, terpene resins, urea-formaldehyde reins, styrene po ymers, inyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacryla es, po s, hydroxypropylmethylcellulose, methocel, polyethylene glycol, acrylics, crylic mers, polyurethane, polylactic acid, polyhydrox outy oxyvalerate copolymers, starches, soybean protein, waxes, and mixtures t ereo .

2. An arti le of cture as defined in claim 1, wherein the starch-based binder comprises a starch ted from the group consisting of potato starch, corn starch, waxy corn starc , rice , wheat starch, starches derived from cereals, tubers, and roots, and mixtu s ther .

3. An arti e of cture as defined in claim 1, wherein the starch-based binder is included i an am a range from about 10% to about 80% by weight of total solids in the starch boun r matrix.

4. An arti le o cture as defined in claim 1, wherein the starch-based binder is included i an a range from about 30% to about 70% by weight of total solids in the starch boun r matrix.

5. An arti le of cture as defined in claim 1, wherein the starch-based binder is included i an a a range from about 40% to about 60% by weight of total solids in the starch bound r matrix.

6. An arti le of cture as defined in claim 1, further including an inorganic aggregate iller tially homogeneously dispersed throughout the starch-bound cellular trix .

7. An arti le cture as defined in claim 6, wherein the inorganic aggregate filler co pri carbonate.

8. An arti le o cture as defined in claim 6, wherein the inorganic aggregate filler is elec the group consisting of perlite, vermiculite, sand, crushed sandstone, crus tone, glass beads, hollow glass spheres, mica, clay, kaolin, crushed r , rock, and mixtures thereof.

9. An arti le o cture as defined in claim 6, wherein the inorganic aggregate filler is wh le amount in a range from about 20% to about 90% by weight of total solids in the a nd cellular matrix.

10. An article of cture as defined in claim 6, wherein the inorganic aggregate filler is ed amount in a range from about 30% to about 70% by weight of total solids in al nd cellular matrix.

11. An article cture as defined in claim 1, wherein the starch-bound cellular matrix fu a mold-release agent.

12. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix fu fibers substantially homogeneously dispersed throughout the starch-bou trix.

13. An article of cture as defined in claim 12, wherein the fibers are selected from the g of sisal, hemp, cotton, plant, leaf, abaca, bagasse, wood, graphite, c, and metal fibers, and mixtures thereof.

14. An article of cture as defined in claim 12, wherein a portion of the starch-ba ides pregelatinized or modified starch.

15. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix fu a natural polymer selected from the group consisting of alginic acid, phyc , gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth ed materials, protein-based materials, and mixtures thereof.

16. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix fu a synthetic polymer selected from the group consisting of polyvinyl ol, inyl acetate, polyacrylic acid, polylactic acid, and mixtures thereof.

17. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix ha a range from about 0.05 g/cm.sup.3 to about 1 g/cm.sup.3.

18. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix ha a range from about 0.1 g/cm.sup.3 to about 0.5 g/cm.sup.3.

19. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix is a container selected from the group consisting of cups, plates, clam-shel ays, and bowls.

20. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix has ick to about 10 cm.

21. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix ha ick a range from about 1 mm to about 1 cm.

22. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix ha a range from about 2 mm to about 5 mm.

23. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix fu a plasticizer.

24. An article of cture as defined in claim 23, wherein the plasticizer is selected from the of glycerin, monoglycerides, diglycerides, polyethylene glycol, sorbitol, ixt ereof.

25. An article of cture as defined in claim 1, wherein the starch-bound cellular matrix fu an organic particulate filler.

26. An article of cture as defined in claim 1, wherein the coating is applied to the outer the starch-bound cellular a liquid which subsequently hardens t ight barrier.

27. An article of ure as defined in claim 1, further including an additional coating a er skin portion of the starch-bound cellular matrix selected from the of other cellulosic ethers, cellulose acetate, other cellulose ma polyethylene, mixtures of the foregoing, and derivatives of the foreg

28. An article of ure as defined in claim 1, wherein the coating further includes an inorga rial dispersed therein.

29. An article of ure as defined in claim 1, further including an inorganic coating ma to the outer skin portion of the starch-bound cellular matrix selected nsisting of sodium silicate, calcium carbonate, aluminum oxide, silicon c y, ceramics, and mixtures thereof.

30. An article of ure as defined in claim 1, wherein the coating is applied to the outer the starch-bound cellular matrix as a laminating material.

31. An article of ure as defined in claim 30, wherein the laminating material is applied i ubstantially uniform film.

32. An article of ure as defined in claim 30, wherein the laminating material is applied i heet.

33. An article of ure as defined in claim 30, wherein the laminating material is selected nsisting of polylactic acid, polyhydrc yvalerate copolymer, other polyesters, polyvinyl alcohol, polyvinyl yl chloride, polyamides, melamine, hydroxypr e, methylcellulose, and mixtures of the foregoing.

34. An article of ure as defined in claim 1, wherein the coating is utilized as an adhesi

35. An article of ure as defined in claim 1, wherein the starch-bound cellular matrix de nged exposure to water.

36. An article of ure comprising: a starch- rix formed by gelatinizing a starch-based binder in water and then caus ed binder to substantially harden by removing a substantial portion o poration to thereby forming the starch-bound cellular matrix,

wherein t… …llular matrix further inclu…s optional components dispersed
therein, h… …ss than about 1 cm, and d…grade… after prolonged exposure to
water; and
a coating …p… …ed …st a portion of the starch-bound cellular matrix, wherein the
coating c… …r… …es … …adable polymer selected from the group consisting of
biodegrad… …e… …oly… polyvinyl acetate, polyvinyl alcohol, starches, polylactic
acid, pol… …xyb… hydroxyvalerate copolymer, other biodegradable polyesters,
hydroxypr… …thy… …e, methocel, soybean protein, and mixtures thereof.
37. An ar… …f… …re as defined in claim 36, wherein the starch-bound cellular
matrix in… …a… …in portion having a density and an interior foam portion
having a c… …nificantly lower than the density of the outer skin portion.
38. An art… …i… …re as defined in claim 36, wherein the coating is applied to
the starch… …o… …i c… …s a liquid which subsequently hardens to form a substantially
solidifie… …ing
39. An ar… …of … …re as defined in claim 36, wherein the coating is applied to
the starc… …d c… …s a laminating material.
40. An ar… …f … …re as defined in claim 36, wherein the coating is applied to
the starc… …d c… …s an adhesive.
41. An ar… …f… …re as defined in claim 36, further including an additional
coating a… …to… …skin portion of the starch-bound cellular matrix selected
from the g… …or… …other cellulosic ethers, cellulose acetate, other
biodegrada… …e… …ll… …ed polymer materials, other biodegradable polymers,
polyethyle… …, …xe… …atives of the foregoing, and mixtures of the foregoing.
42. A meth… …m… …ing articles of manufacture having a starch-bound cellular
matrix co… …g:
heating a… …us… …ased mixture including starch and water in order to first
gelatiniz… …sta… …hen cause it to substantially solidify as a result of
evaporati… …wat… …rom to thereby form the starch-bound cellular matrix in a
desired s… …e of manufacture; and
applying a… …ta… …ting to at least a portion of the starch-bound cellular
matrix.
43. A meth… …de… …claim 42, wherein the laminate film coating is a film or sheet
comprising… …st… …stomer selected from the group consisting of polylactic acid,
polyhydro… …xyl… …valerate copolymer, other biodegradable polyesters, polyvinyl
alcohol, …yl… …polyvinyl chloride, polyamides, melamine, cellulosic others,
cellulose… …e… …lulosic polymers, starches, other biodegradable polymers,
polyethyl… …d… …of the foregoing.
44. A met… …d… …claim 42, further including an inorganic filler dispersed
within th… …ai…
45. A meth… …d… …claim 42, wherein the starch-based mixture further includes
fibers di… …r… …
46. A meth… …d… …claim 42, wherein the starch-based mixture further includes an
inorganic … …d … …therein.
47. A met… …d… …claim 42, wherein the starch-bound cellular matrix has a
thickness … …s … …5 mm.
48. A meth… …de… …claim 42, wherein the starch-bound cellular matrix includes an
outer ski… …er h… …density and an interior foam portion having a density that is
significa… …s… …density of the outer skin portion.
49. A meth… …r… …ing articles of manufacture having a starch-bound cellular
matrix co… …g:
heating a… …ous… …ased mixture including starch and water in order to first
gelatiniz… …ne… …sta… …hen cause it to substantially solidify as a result of
evaporati… …wat… …rom to thereby form the starch-bound cellular matrix in a
desired s… …e… …of manufacture; and
applying a… …ing… …at a portion of the starch-bound cellular matrix selected
from the … …consi… …edible oils, drying oils, waxes, phenolic resins,
polyester … …, e… …ins, terpene resins, urea-formaldehyde resins, styrene
polymers, …n… …vinyl chloride, polyvinyl alcohol, polyvinyl acetate,
polyacryl… …ra… …ydroxypropylmethylcellulose, methocel, poyethylene glycol,
acrylics, …c… …, polyurethane, polylactic acid,
polyhydro… …at… …valerate copolymers, starches, soybean protein, waxes, and
mixtures … …
50. A met… …d… …laim 49, wherein the coating further includes an inorganic
filler di… …e…
51. A met… …defi… …laim 49, wherein the starch-based mixture further includes an
inorganic …
52. A met… …f… …laim 49, wherein the starch-based mixture further includes
fibers di… …r…
53. A meth… …o… …laim 49, wherein the coating is applied as a laminate film.

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L5: Entry 46 File: USPT Jul 4, 2000

US-PAT-NO: 6083586
DOCUMENT-IDENTIFIER: US 6083586 A

TITLE: Sheets having a starch-based binding matrix

DATE-ISSUED: July 4, 2000

INVENTOR-INFORMATION:

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US-CL-CURRENT: 428/36.4; 106/206.1, 106/217.01, 106/400, 206/524.3, 206/524.7, 428/317.9, 428/36.5, 442/2, 442/76

CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. A starch bound sheet comprising:
a binding matrix including starch and a cellulosic ether, wherein the binding matrix is formed by at least partially gelating the starch in water and then causing the starch to substantially harden by removing a substantial portion of the water by evaporation, wherein the combined concentration of the starch and cellulosic ether is greater than about 20% by weight of the solids in the sheet;
fibers substantially homogeneously dispersed throughout the binding matrix and having an average aspect ratio greater than about 10:1; and
an inorganic mineral filler included in an amount up to about 80% by weight of solids in the sheet
wherein the starch-bound sheet has a thickness of less than about 1 cm and a density greater than about 0.5 g/cm.sup.3 and is sufficiently flexible so that it can be significantly mechanically deformed by at least one process selected from the group consisting of crimping, creping, stretching, bending, folding, rolling, convoluting, spiral winding, pressing, flexing, and corrugating without complete rupture of the sheet.

2. A sheet as defined in claim 1, wherein the starch has a concentration in a range from about 15% to about 75% by weight of total solids in the sheet.
3. A sheet as defined in claim 1, wherein the starch has a concentration in a range from about 30% to about 70% by weight of total solids in the sheet.
4. A sheet as defined in claim 1, wherein the starch has a gelation temperature and the cellulosic ether has a thermal precipitation temperature such that the gelation temperature of the starch is greater than the thermal gelation temperature of the cellulosic ether.
5. A sheet as defined in claim 1, wherein the binding matrix further includes a protein-based binder selected from the group consisting of prolamine, collagen, animal glue, casein, and mixtures or derivatives thereof.
6. A sheet as defined in claim 1, wherein the binding matrix further includes a polysaccharide selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
7. A sheet as defined in claim 1, wherein the binding matrix further includes a synthetic organic binder selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyacrylamide, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, latex, and mixtures or derivatives thereof.
8. A sheet as defined in claim 1, wherein the inorganic mineral filler has a concentration in a range from about 20% to about 80% by weight of total solids in the sheet.
9. A sheet as defined in claim 1, wherein the fibers have a concentration in a range from

about 3% [illegible] 40% [illegible] of total solids in th[illegible] sheet.

10. A sheet as defin[illegible] claim 1, wherein the sheet [illegible] a thickness of less than about 1 mm.

11. A sheet as defin[illegible] claim 1, wherein the sheet has a thickness of less than about 0.1 mm.

12. A she[illegible] defined [illegible] claim 1, wherein the sheet [illegible] a density greater than about 1 g/cm.sup.[illegible]

13. A she[illegible] defin[illegible] claim 1, wherein the sheet [illegible] water degradable.

14. A she[illegible] define[illegible] claim 1, wherein the sheet [illegible] includes a coating.

15. A she[illegible] define[illegible] claim 1, wherein the sheet [illegible] includes at least one other sheet lam[illegible]na[illegible] there[illegible]

16. A sheet as defin[illegible] claim 1, wherein the sheet [illegible] includes a hinge.

17. A sheet as defin[illegible] claim 16, wherein the coati[illegible] is selected from the group consisting [illegible] [illegible]ible [illegible] amine, polyvinyl chlori[illegible], polyvinyl alcohol, polyvinyl acetate, [illegible] [illegible]rylates [illegible] [illegible]ides, hydroxypropylmethylcellulose, methocel, other cellulosi[illegible] [illegible] po[illegible] [illegible] glycol, acrylics, polyurethane, polyethylene, polylactic acid, pol[illegible] [illegible]oxybu[illegible] [illegible] [illegible]oxyvalerate copolymers, [illegible] starches, soybean protein, soybean o[illegible] [illegible] w[illegible]s, elastomers biodegra[illegible] polymers, sodium silicate, calcium c[illegible] [illegible]ide, silicon oxide, kaoli[illegible], clay, ceramic and mixtures thereof.

18. A she[illegible] [illegible] claim 16, wherein the at le[illegible] one other sheet is selected from the group consisting [illegible] [illegible]-bound sheets, organic [illegible]ymer sheets, metal foil sheets, ionomer s[illegible] [illegible] [illegible]eets, plastic sheets, [illegible] sheets, mats, paper sheets, cellophan[illegible] [illegible]s, ny[illegible] [illegible]s, wax sheets, hydraulic[illegible]y settable sheets, highly inorganic[illegible] [illegible]lled [illegible] metallized film sheets and combinations thereof.

19. A she[illegible] defin[illegible] claim 1, wherein the sheet [illegible] been fashioned into a container.

20. A she[illegible] defin[illegible] claim 1, wherein the sheet [illegible]prises a continuous sheet that has been [illegible] onto [illegible]

21. A she[illegible] defin[illegible] claim 1, wherein the fibers [illegible] a length greater than about 1.5 mm.

22. A sta[illegible] [illegible]sing: a binding [illegible] [illegible]rch and a cellulosic eth[illegible], wherein the starch has a concentra[illegible] [illegible] about 5% to about 90% by weight of solids in the sheet; fibers in[illegible] [illegible] at least about 3% by [illegible] of solids in the sheet and being sub[illegible] [illegible]ly dispersed throughou[illegible] binding matrix, the fibers having an [illegible] greater than about 10:[illegible] [illegible] an inorga[illegible] [illegible]cluded in a range from [illegible] to about 90% by weight of solids in [illegible] [illegible]-bound sheet having a [illegible]ness less than about 1 cm and a density g[illegible] [illegible] g/cm.sup.3.

23. A she[illegible] claim 22, wherein the fiber[illegible] have a concentration in a range from abou[illegible] [illegible] weight of total solids i[illegible] the sheet.

24. A she[illegible] [illegible] 22, wherein the cellul[illegible] ether has a concentration in a range fro[illegible] [illegible] 10% by weight of total [illegible] [illegible]ids in the sheet.

25. A she[illegible] [illegible] cl[illegible] 22, wherein the starc[illegible] has a gelation temperature and the cellulosi[illegible] [illegible]rma[illegible] precipitation temper[illegible] [illegible] such that the gelation temperatu[illegible] [illegible]s [illegible]eater than the therm[illegible] [illegible]ation temperature of the cellulosi[illegible]

26. An i[illegible] [illegible]rch-bound sheet compri[illegible]: a binding [illegible] [illegible]rch and a cellulosic ether, the starch having a concentra[illegible] [illegible] about 5% to about 75% by weight of solids in the sheet; fibers su[illegible] [illegible]ly dispersed throughout the binding matrix and having an aspect ra[illegible] [illegible] 10:1; and an inorga[illegible] [illegible]cluded in a range from [illegible] 20% to about 90% by weight of solids in [illegible] [illegible]-bound sh[illegible] having a [illegible]ness less than about 1 cm and a density g[illegible] [illegible] g/cm.sup.[illegible]

27. An in[illegible] [illegible]arch-bound sheet as defi[illegible] in claim 26, wherein the binding m[illegible] [illegible] a protein based binde[illegible] selected from the group consisting of prola[illegible] [illegible], glue, casein, and mixtures or derivatives thereof.

28. An i[illegible] [illegible]rch-bound sheet as defined in claim 26, wherein the binding m[illegible] [illegible] a polysaccharide selected from the group consisting of alginic [illegible] [illegible], gum arabic, guar gum, locust bean gum, gum karaya, gum tragacan[illegible] [illegible]ivatives thereof.

29. An i[illegible] [illegible]rch-bound sheet as defined in claim 26, wherein the binding [illegible] [illegible] a synthet[illegible] organic [illegible] selected from the group consisti[illegible] [illegible]done, poly[illegible]ylene g[illegible] polyvinyl alcohol, polyviny[illegible] [illegible] acids, polyacrylic [illegible] salts, polyvinylacrylic acids, polyviny[illegible] [illegible]ycrylimi[illegible]s, polyla[illegible] acid, ethylene oxide polymers, latex, a[illegible] [illegible] thereo[illegible]

30. An i[illegible] [illegible]h-bound [illegible]eet as defined in claim 26, wherein the sheet has a th[illegible] [illegible] mm.

31. An i[illegible] [illegible]h-bound [illegible]eet as defined in claim 26, wherein the sheet has a de[illegible] [illegible] g/cm.s[illegible]3.

32. An i[illegible] [illegible]h-bound [illegible]eet as de[illegible] in claim 26, wherein the sheet

is water
33. An i… …-bound sheet as d…ined in claim 26, wherein the sheet
further …o… …least a p…rtion th…
34. An i… …-bound sheet as d…ined in claim 33, wherein the
coating … …is consisting of edi… oils, melamine, polyvinyl
chloride, … …lyvinyl ac…ate, poly…, polyamides,
hydroxyp… …ethocel, o…er cellu…ethers, polyethylene glycol,
acrylics … …ylene, poly…actic acid,
polyhydr… …rene copoly…ers, late…, st…rches, soybean protein,
soybean … …s, elastom…s, biodeg…dable polymers, sodium silicate,
calcium … …d, silico…oxide, ka…lin, clay, ceramic and mixtures
thereof.
35. An i… …-bound sheet as d…ined in claim 33, wherein the at
least on… …from th… group co…sting of starch-bound sheets,
organic … …oil sheets, ionomer …eets, elastomeric sheets, plastic
sheets, … …aper sheet… cellopha…e sheets, nylon sheets, wax sheets,
hydraulic… …highly ino…anically filled sheets, metallized film sheets
and comb…
36. An i… …-bound sheet as d…ined in claim 26, wherein the sheet
further … …er sheet… minated …eto.
37. An i… …-bound …eet as d…ined in claim 26, wherein the sheet
includes …
38. An i… …-bound …eet as d…ined in claim 26, wherein the sheet
is fashi…
39. An i… …-bound sheet as d…ined in claim 26, wherein the sheet
comprise… …has bee…rolled on…spool.
40. A st… …by passing a starch-based composition between least one
set of h… …rch-bound s…eet having …thickness less than about 1 cm and
a densit… …/cm.sup.…, the st…ch-based composition comprising:
(a) wate…
(b) unge… …a… e. having …concentr…ion in a range from about 5% to
about 90 … …l …lis in th… starch-based composition, the starch granules
having a …
(c) a ce… …thermal precipitatio…temperature that is less than the
gelation … …n granules…
(d) an i… …having a …centration in a range from about 0% to about
90% by w… …starch-bas…l composi…n, and
(e) fibe… …ously di…rsed th…ghout the starch-based composition.

41. A st…c… …ined in cl…m 40, wh…at least a portion of the
ungelati… …e… the star…based c…sition become at least partially
gelatini… …he starch-b…d sheet.
42. A st… …ined in claim 40, wh…ein the cellulosic ether reduces
adhesion … …n composition and th…ed rollers during formation of
the star…
43. A st… …ined in cl…m 40, wh…ein the sheet has the thickness of
less tha… a…
44. A st… …ined in cl…m 40, wh…ein the sheet has the thickness of
less tha… a…
45. A st… …ined in cl…m 40, wh…ein the sheet has a density greater
than abo…
46. A st… …ined in claim 40, wh…ein the sheet further includes a
coating … …eof.
47. A st… …ined in cl…m 46, wh…ein the coating is selected from the
group co… …s, melamine, polyvinyl chloride, polyvinyl alcohol,
polyviny… …es polyami…s, hydrox…pylethylcellulose, methocel,
other ce… …poly…hylene glycol, acryl…s, polyurethane, polyethylene,
polylac… …ty…ty…ate-hydro…yvalerat…copolymers, latexes, starches,
soybean … …polyethylen…waxes, …ners, biodegradable polymers,
sodium … …ate, alumi…m oxide, sil…con oxide, kaolin, clay, ceramic
and mixt…
48. A st… …ined in cla…m 40, wh…ein the sheet is fashioned into a
containe…
49. A st… …fined in cla…m 40, wh…ein the sheet comprises a continuous
sheet th… …o… spool.
50. A st… …as defi…ed in cl…m 40, wh…ein the sheet further includes at
least o… …na…d thereto.
51. A st… …fined in cl…m 50, wh…ein the at least one other sheet is
selecte… …consisting of st…ch-bound …eets, …rganic polymer sheets, metal
foil sh… …, …lastomeric …eets, pl…tic sheets, fibrous sheets, mats,
paper sh…ts, …ets, nylon she…ts, wax …eets, …ydraulically settable sheets,
highly i… …s, metal…ed film sheets and combinations thereof.
52. A st… …fined in cla…m 40, wh…ein the starch-based composition
further … …ly settable …der.

53. A st[illegible] s defined in claim 40, wherein the fibers have a concentration in a ran[illegible] to about 40% by weight of total solids in the starch-based composit[illegible]

54. A st[illegible] formed by passing an aqueous starch-based composition between at least on[illegible] rollers in order to remove a substantial portion of water by evaporat[illegible] olidify the sheet, the starch-bound sheet having a thickness less than abo[illegible] nsity greater than about 0.5 g/cm.sup.3 and being sufficiently flexible [illegible] ar[illegible] si[illegible]nificantly mechanically deformed by at least one process selected [illegible] u[illegible]nsisting of crimping, creping, stretching, bending, folding, rolling, [illegible] al[illegible]inding, pressing, fluting, and corrugating without complete rupture o[illegible] s
the aquer[illegible] composition comprising:
water;
substant[illegible] ed starch granules having a concentration in a range from about 5% to ab[illegible] of total solids in the starch-based composition and having a gelation [illegible]
a cellul[illegible]i[illegible]th hav[illegible] a thermal precipitation temperature that is less than the gelation [illegible]e of [illegible]e substantially ungelatinized starch granules; and
an inorg[illegible] [illegible]r having a concentration [illegible] a range from about 0% to about 90% by weigh[illegible] [illegible] starch-based composition.

55. An ir[illegible] ed starch-bound sheet as defined in claim 54, further including fibers i[illegible] out 3% to about 40% by weight of total solids in the starch-b[illegible]

56. An i[illegible] ed starch-bound sheet formed by a process comprising the steps of:
providin[illegible] aqu[illegible] s s[illegible]ch-based composition including water, starch, a cellulosic either, [illegible]c[illegible] i[illegible] [illegible]aine[illegible]al filler, wherein the water has a concentration in a range from abo[illegible] [illegible] by weight of the starch-based composition, wherein the inorgani[illegible] [illegible]as a concentration of up to about 30% by weight of solids, and wherein t[illegible] [illegible]llulosic ether have a combined concentration of at least about 20% by w[illegible] [illegible] and
passing [illegible] composition betwe[illegible]en at least one set of heated rollers in order to remov[illegible] [illegible]ortion of the water by evaporation to thereby solidify the sheet, w[illegible] [illegible]fied sheet has a thickness of less than about 1 cm and a density greater [illegible] [illegible] cm.sup.3.

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TITLE: Hinges for highly inorganically filled composite materials

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INVENTOR-INFORMATION:

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CLAIMS:

What is claimed and desired to be secured by United States Letters Patent is:
1. An article of manufacture comprising a hinged inorganically filled matrix including a substantially homogenous mixture of aggregate and organic binder, said matrix being formed from an inorganically filled mixture comprising water, a water-dispersible organic polymer binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof, an inorganic aggregate material having a concentration in a range from about 40% to about 98% by volume of total solids in said inorganically filled mixture, and a fibrous material substantially homogeneously dispersed throughout said inorganically filled matrix.
2. The article of manufacture of claim 1, wherein said hinged matrix includes a living hinge.
3. The article of manufacture of claim 1, wherein said hinged matrix includes a nonliving hinge.
4. The article of manufacture of claim 1, wherein said hinged inorganically filled matrix has a thickness in a range from about 0.01 mm to about 1 mm.
5. The article of manufacture of claim 1, wherein said hinged inorganically filled matrix has a thickness in a range from about 0.05 mm to about 0.5 mm.
6. The article of manufacture of claim 1, wherein said inorganic aggregate material has a concentration in a range from about 50% to about 95% by volume of the total solids in the matrix.
7. The article of manufacture of claim 1, wherein said inorganic aggregate material has a concentration in a range from about 60% to about 80% by volume of the total solids in the matrix.
8. The article of manufacture of claim 1, wherein said inorganic aggregate material comprises at least two different aggregate materials.
9. The article of manufacture of claim 1, wherein said inorganic aggregate material comprises individual particles that are size optimized in order to achieve a predetermined particle packing density of the aggregate.
10. The article of manufacture of claim 9, wherein said particle packing density of said aggregate material is at least about 0.65.
11. The article of manufacture of claim 9, wherein said particle packing density of said aggregate material is at least about 0.75.
12. The article of manufacture of claim 9, wherein said particle packing density of said aggregate material is at least about 0.85.
13. The article of manufacture of claim 1, wherein said inorganic aggregate material comprises a lightweight aggregate that reduces the density and increases the insulation ability of said hinged matrix.
14. The article of manufacture of claim 13, wherein said lightweight aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, lightweight expanded geologic materials, pumice, and mixtures thereof.
15. The article of manufacture of claim 1, wherein said inorganic aggregate material is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandstone, limestone, and mixtures thereof.

16. The article of manuf[illegible]re of claim 1, wherein said inorganically filled matrix also includes an organic aggr[illegible] selected from the group consisting of cork, seeds, starches, gelatins, agar [illegible]erials, and mixtures thereof.
17. The article of manuf[illegible]re of claim 1, wherein said inorganic aggregate material includes an inorganic ge[illegible]
18. The article of manuf[illegible]re of claim 17, wherein said inorganic gel is selected from the group consisting of [illegible]ca gel, aluminum silicate gel, calcium silicate gel, and mixtures thereof.
19. The article of manuf[illegible]re of claim 17, wherein said inorganic gel has a concentration within the [illegible]organically filled matrix such that a predetermined amount of moisture is maintained w[illegible]n the matrix.
20. The article of manuf[illegible]re of claim 1, wherein said inorganic aggregate material includes an inorganic ma[illegible]l that is precipitated in situ.
21. The article of manuf[illegible]re of claim 1, wherein said inorganic aggregate material comprises a polymerized [illegible]ate.
22. The article of manu[illegible]re of claim 1, wherein the concentration of said water-dispersible organic [illegible]ymer binder is in a range from about 1% to about 50% by volume of the total soli[illegible]n the inorganically filled matrix.
23. The article of manuf[illegible]re of claim 1, wherein the concentration of said water-dispersible organi[illegible]lymer binder is in a range from about 2% to about 30% by volume of the total soli[illegible]n the inorganically filled matrix.
24. The article of manu[illegible]e of claim 1, wherein the concentration of said water-dispersible organ[illegible]ymer binder is in a range from about 5% to about 20% by volume of the total soli[illegible]n the inorganically filled matrix.
25. The article of manu[illegible]e of claim 1, wherein said water-dispersible organic polymer binder comprises a cellu[illegible]based polymer.
26. The article of manuf[illegible]re of claim 25, wherein said cellulose-based polymer is selected from the group [illegible]isting of methylhydroxyethylcellulose, hydroxymethylethylcellul[illegible] carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, [illegible]xyethylpropylcellulose, and mixtures thereof.
27. The article of manu[illegible]e of claim 1, wherein said water-dispersible organic polymer binder comprises a starch-based polymer.
28. The article of manu[illegible]e of claim 27, wherein said starch-based polymer is selected from the group consisti[illegible] amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ion[illegible]arches, long-chain alkylstarches, dextrins, amine starches, phosphate starches, dial[illegible]de starches, and mixtures thereof.
29. The article of manu[illegible]re of claim 1, wherein said water-dispersible organic polymer binder comprises a prote[illegible]ased material.
30. The article of manu[illegible]re of claim 29, wherein said protein-based material is selected from the group [illegible]sting of prolamine, collagen, gelatin, glue, casein, and mixtures thereof.
31. The article of manu[illegible] of claim 1, wherein said water-dispersible organic polymer binder is selected from [illegible]roup consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locus[illegible] gum, gum karaya, gum tragacanth, and mixtures thereof.
32. The article of manu[illegible]e of claim 1, wherein said water-dispersible organic polymer binder further comprise[illegible]ynthetic organic polymer.
33. The article of manu[illegible]ture of claim 32, wherein said synthetic organic polymer is selected from the group [illegible]sisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, poly[illegible]ethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, [illegible]nylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers[illegible]hetic clay, latex, and mixtures thereof.
34. The article of manu[illegible]e of claim 1, wherein said fibrous material has a concentration in a rang[illegible] about 0.5% to about 50% by volume of the total solids in the inorganically fille[illegible]rix.
35. The article of manu[illegible]e of claim 1, wherein said fibrous material has a concentration in a ran[illegible]om about 2% to about 30% by volume of the total solids in the inorganically filled m[illegible]x.
36. The article of manu[illegible]e of claim 1, wherein said fibrous material has a concentration in a ran[illegible] about 5% to about 20% by volume of the total solids in the inorganically filled m[illegible]
37. The article of manu[illegible]e of claim 1, wherein said fibrous material comprises organic fibers.
38. The article of manu[illegible]e of claim 37, wherein said organic fibers are selected from the group consisting of[illegible]emp, cotton, bagasse, abaca, flax, southern pine, southern hardwood fibers, and m[illegible] thereof.
39. The article of manu[illegible]ture of claim 1, wherein said fibrous material comprises inorganic fibers.
40. The article of manu[illegible] of claim 39, wherein said inorganic fibers are selected from the group consist[illegible]lass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mixt[illegible]reof.
41. The article of manu[illegible]e of claim 1, wherein said fibrous material comprises a mixture of different f[illegible]ving varying strengths and flexibilities.
42. The article of manu[illegible] of claim 1, wherein said fibrous material increases the tensile strength of th[illegible]anically filled matrix.

43. The article of man of claim 1, wherein said fibrous material increases the flexibility of the inorganically filled matrix.
44. The article of man of claim 1, wherein the aspect ratio of the individual fibers within said fibrous material is at least about 10:1.
45. The article of man of claim 1, wherein the aspect ratio of the individual fibers within said fibrous material is at least about 100:1.
46. The article of man of claim 1, wherein the aspect ratio of the individual fibers within said fibrous material is at least about 1000:1.
47. The article of man of claim 1, wherein said fibrous material comprises individual fibers that substantially random orientation within said inorganically filled matrix.
48. The article of man of claim 1, wherein said fibrous material comprises individual fibers that substantially unidirectional orientation within said inorganically filled matrix.
49. The article of man of claim 1, wherein said fibrous material comprises individual fibers that substantially bidirectional orientation within said inorganically filled matrix.
50. The article of man of claim 1, wherein said inorganically filled matrix includes a surface and interior each having fibers positioned thereat, said fibers positioned at said surface being more uniformly oriented along a defined direction than said fibers at said interior of said matrix.
51. The article of man of claim 1, wherein said aggregate material comprises a hydraulically settable material.
52. The article of man of claim 51, wherein said hydraulically settable material comprises a hydraulic cement.
53. The article of man of claims 52, wherein said hydraulic cement comprises portland grey cement.
54. The article of man of claim 52, wherein said hydraulic cement is selected from the group consisting portland white cement, slag cement, calcium aluminate cement, silicate cement, aluminate cement, high-alumina cement, magnesium oxychloride cement, aggregates consisting microfine cement particles, Macro-Defect-Free (MDF) cement, and mixtures thereof.
55. The article of man of claim 51, wherein said hydraulically settable material comprises calcium sulfate hydrate.
56. The article of man of claim 51, wherein said hydraulically settable material comprises calcium oxide.
57. The article of man of claim 51, wherein said hydraulically settable material has a concentration within said inorganically filled matrix great enough to impart a binding effect within said matrix.
58. The article of man of claim 1, wherein said inorganically filled matrix is water degradable.
59. The article of man of claim 1, wherein said inorganically filled matrix is readily degradable into environmentally neutral components.
60. The article of man of claim 1, further comprising a coating material on a surface of said inorganically filled matrix.
61. The article of man of claim 60, wherein said coating material increases the ability of said inorganically filled matrix to resist water penetration.
62. The article of man of claim 60, wherein said coating material increases the flexibility of said inorganically filled matrix.
63. The article of man of claim 60, wherein said coating material comprises a biodegradable material.
64. The article of man of claim 60, wherein said coating material is selected from the group consisting melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastible oils, and mixtures thereof.
65. The article of man of claim 60, wherein said coating material is selected from the group consisting sodium silicate, calcium carbonate, kaolin, silicon oxide, aluminum oxide, ceramics, mixtures thereof.
66. The article of man of claim 1, wherein said inorganically filled matrix has a tensile strength in a range from about 0.05 MPa to about 1 MPa.
67. The article of man of claim 1, wherein said inorganically filled matrix has a tensile strength in a range from about 5 MPa to about 40 MPa.
68. The article of man of claim 1, wherein said inorganically filled matrix has a bulk density in a range from about 0.4 g/cm.sup.3 to about 1 g/cm.sup.3.
69. The article of man of claim 1, wherein said inorganically filled matrix has a bulk density in a range from about 0.4 g/cm.sup.3 to about 1.5 g/cm.sup.3.
70. The article of man of claim 1, wherein said inorganically filled matrix has a tensile strength to bulk density ratio in a range from about 2 MPa-cm.sup.3 /g to about 200 MPa-cm.sup.3 /g.
71. The article of man of claim 1, wherein said inorganically filled matrix has a tensile strength to bulk density ratio in a range from about 3 MPa-cm.sup.3 /g to about 50 MPa-cm.sup.3 /g.
72. The article of man of claim 1, wherein said inorganically filled matrix can

elongate in a range f... 0.5% to about 8% without completely fracturing when dry.
73. The article of ma... of claim 1, wherein said inorganically filled matrix can elongate up to about ... it completely fracturing when moist.
74. The article of ma... of claim 1, wherein said hinged matrix is formed by cutting or pressing a ... said inorganically filled matrix.
75. The article of ma... of claim 1, wherein said hinged matrix is formed by molding said inorgani... ed mixture.
76. The article of ma... of claim 1, wherein said inorganically filled matrix is perforated.
77. The article of ma... of claim 1, wherein said inorganically filled matrix includes ... finely dispe... roids.
78. The article of ma... of claim 1, wherein said hinged matrix may be bent up to an angle of about 90... without substantially fracturing said matrix.
79. The article of ma... of claim 1, wherein said hinged matrix may be bent up to an angle of about 180... without substantially fracturing said matrix.
80. The article of ma... of claim 1, wherein said hinged matrix may be bent up to an angle of about 360... without substantially fracturing said matrix.
81. The article of ma... of claim 1, wherein said inorganically filled matrix is flexible.
82. The article of ma... of claim 1, wherein said hinged matrix further comprises a pulp-containing mater... ed thereon.
83. The article of ma... of claim 84, wherein said pulp-containing material is a paper strip.
84. An inorganically ... et that has been scored to produce the hinged matrix defined by claim 1.
85. An inorganically ... et that has been molded to produce the hinged matrix defined by claim 1.
86. An article of manu... comprising a hinged inorganically filled matrix including a substantially homogen... re of aggregate and organic binder, said matrix being formed from an inorga... lled mixture comprising:
(b) a water-dispersibl... ga... polymer binder selected from the group consisting of polysaccharides, prote... ar... mixtures or derivatives thereof and having a concentration in a rang... from about ... o... ut 50% by volume of total solids in the inorganically filled mixture;
(c) an inorganic aggr... ...erial having a concentration in a range from about 40% to about 98% by volume o... ...olids in the inorganically filled mixture; and
(d) a fibrous materia... ...concentration in a range from about 0.5% to about 50% by volume of total solic... ...inorganically filled mixture, wherein said hinged matrix has a thickness of al... ...m to about 1 mm, and wherein said fibrous material is substantially homogene... ...spersed throughout said inorganically filled matrix.
87. The article of manu... tu... of claim 86, wherein said hinged matrix has a thickness in a range from about 0.... t... about 0.5 mm.
88. The article of ma... ...s of claim 86, further comprising a coating on at least a portion of a surface ... ...norganically filled matrix.
89. The article of ma... of claim 86, wherein said hinged matrix further comprises a pulp-containing mat... ...osed thereon.
90. The article of ma... of claim 89, wherein said pulp-containing material is a paper str...
91. An article of manu... ...comprising a hinged inorganically filled matrix including a substantially homogeneo... ix... re of an inorganic aggregate and an organic binder, said matrix further includ... ih... s substantially homogeneously dispersed throughout said inorganically filled ... x, ...aid organic binder being selected from the group consisting of polysaccharides, p... ...s and mixtures or derivatives thereof, said inorganic aggregate having a co... ...on in a range from about 40% to about 98% by volume of total solids in said ... ...lly filled matrix.
92. The article of ma... of claim 91, wherein said inorganic aggregate is selected from the group consis... ...lay, gypsum, calcium carbonate, mica, silica, alumina, sand, gravel, sandsto... ...one, and mixtures thereof.
93. The article of manu... ...t... of claim 91, wherein the concentration of said organic binder is in a range f... ...ab... t 1% to about 50% by volume of the total solids in the inorganically filled ... ...x.
94. The article of ma... ...e of claim 91, wherein said organic binder comprises a cellulosic-based poly... ...ted from the group consisting of methylhydroxyethylcel... ...ydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethy... ..., hydroxyethylcellulose, hydrooxyethylpropylcellulose, and mixtures thereof.
95. The article of ma... of claim 91, wherein said organic binder comprises a starch-based polymer ... ...rom the group consisting of amylopectin, amylose, seagel, starch acetates, starch ... ...yethyl ethers, ionic starches, long-chain alkyl starches, dextrins, amine starc... ...phate starches, dialdehyde starches, and mixtures thereof.
96. The article of ma... ...e of claim 91, wherein said organic binder comprises a protein-based materia... s... ed from the group consisting of prolamine, collagen, gelatin, wheat, casein ... ...xtures thereof.

97. The article of ma... e of claim 91, wherein said inorganically filled matrix further co...prises a synthe... organic polymer selected fr... the group consisting of polyvinyl ...rrolidone, pol...thylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacryli... acids, po...c ...acid salts, polyvinylacryli... acids, polyvinylacrylic acids salts, pol...crylimide... ...tic acid, ethylene oxide polymers, synthetic clay, latex and mixtu... thereof.

98. The article of ma... ...e of claim 91, wherein sai... fibers have a concentration in a range from about 0.5% ...t 50% by volume of the total solids in the inorganically filled matrix.

99. The article of ma... ...e of claim 91, wherein said fibers are selected from the group con...sting of organi... fibers, inorganic fibers, and ...ixtures thereof.

100. The article of manufa... ...ure claim 99, wherein said ...ganic fibers are selected from the group ...onsisting ...f s... hemp, cotton, bagasse, abaca, flax, southern pine, southern hardwood, ...d mixture... ...f.

101. The article of ... ...e of claim 99, wherein said inorganic fibers are selected from the group consis... glass fibers, silica fibers, ceramic fibers, carbon fibers, metal fibers, and mix... ...hereof.

102. The article of ... ...e of claim 91, wherein the aspect ratio of the fibers is at least about 10:1.

103. The article of m... ...re of claim 91, wherein said ...norganic aggregate comprises a hydraulica... y settable mat... ...ial.

104. The article of m... ...ure of claim 103, wherein said hydraulically settable material ...mprises a... ...cement.

105. The article of ... ...e of claim 91, wherein said inorganically filled matrix is readily degradable in... ...nvironmentally neutral components.

106. The article of ... ...ure of claim 91, further comprising a coating material on a surface of said hing... ...x.

107. The article of ... ...ure of claim 106, wherein said coating material increases the flexibility of said h... ...trix.

108. The article of m... ...ure of claim 106, wherein said coating material is selected from the ...oup consis... ...melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, ...yacrylate... ...xypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylac... ..., starch, soy bean protein, polyethylene, synthetic polymers, waxes, elas... ...rs, edible oils, sodium silicate, calcium carbonate, kaolin, silicon oxide, alumi... ...xide, ceramic, and mixtures thereof.

109. The article of ... ...ure of claim 91 wherein said hinged matrix further comprises a pulp-containing ma... ...disposed thereon.

110. The article of ... ...ure of claim 109, wherein said pulp-containing material is a paper strip.

111. The article of ... ...ure of claim 91, wherein said hinged matrix is formed by a molding p...ess.

112. An inorganically... ...sheet that has been molded to produce the hinged matrix defined by claim 91.

rch Results - Record(s) 1 through 46 of 46 returned.

☐ 1. S 6083586 A

L5: Entry 4 File: USPT Jul 4, 2000

US-PAT-NO
DOCUMENT- 6083586 A

TITLE: Sh tarch-based binding matrix

DATE-ISSU 0

INVENTOR-

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Ong; Shac	Goleta	CA	N/A	N/A
Christens	Goleta	CA	N/A	N/A
Hodson; S	Santa Barbara	CA	N/A	N/A

US-CL-CUR 106/206.1, 106/217.01, 106/400, 206/524.3, 206/524.7, 428/317.9, 428/36.5, 06

Full Review Classification Date Reference Claims KWIC Draw. Desc Image

☐ 2. S 6030673 A

L5: Entry 3 File: USPT Feb 29, 2000

US-PAT-NO
DOCUMENT- 6030673 A

TITLE: Mo nd containers and other articles having natural and/or synthetic polymer c

DATE-ISSU , 2000

INVENTOR-

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; S	Santa Barbara	CA	N/A	N/A

US-CL-CUR 156/78, 206/524.3, 206/524.7, 427/316, 427/399, 428/317.3, 428/317.9 8/319.1, 428/319.3, 428/319.7, 428/36.5, 428/913

Full Review Classification Date Reference Claims KWIC Draw. Desc Image

☐ 3. JS 5928741 A

L5: Entry File: USPT Jul 27, 1999

US-PAT-NO
DOCUMENT- 5928741 A

TITLE: La d es of manufacture fashioned from sheets having a highly inorganic i ganic polymer matrix

DATE-ISSU 999

INVENTOR-

NAME		CITY	STATE	ZIP CODE	COUNTRY
Andersen;		Santa Barbara	CA	N/A	N/A
Hodson; S	K.	Santa Barbara	CA	N/A	N/A

US-CL-CUR ; 206/524.3, 206/524.7, 428/152, 428/168, 428/182, 428/36.4, 428/36.6, /906

Full Ti Review Classification Date Reference Claims KWIC Draw Desc Image

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☐ 4. US 5868824 A

L5: Entry File: USPT Feb 9, 1999

US-PAT-NO
DOCUMENT- 5868824 A

TITLE: In illed, starch-based compositions for manufacturing containers and other art a thermodynamically controlled cellular matrix

DATE-ISSU , 1999

INVENTOR-

NAME		CITY	STATE	ZIP CODE	COUNTRY
Andersen;		Santa Barbara	CA	N/A	N/A
Hodson; S		Santa Barbara	CA	N/A	N/A

US-CL-CUR .51; 106/164.01, 106/205.01, 106/206.1, 106/217.01, 106/287.35, 106/400,

Full Ti Review Classification Date Reference Claims KWIC Draw Desc Image

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☐ 5. US 5851634 A

L5: Entry File: USPT Dec 22, 1998

US-PAT-NO
DOCUMENT- 5851634 A

TITLE: Hi ly inorganically filled composite materials

DATE-ISSU 22, 1998

INVENTOR-

NAME		CITY	STATE	ZIP CODE	COUNTRY
Andersen;		Santa Barbara	CA	N/A	N/A
Hodson; S		Santa Barbara	CA	N/A	N/A

US-CL-CUR ; 16/221, 16/277, 16/385, 428/168, 428/172, 428/182, 428/317.9, 428/339,

Full Ti Review Classification Date Reference Claims KWIC Draw Desc Image

☐ 6. D. d 1. : US 5830548 A

L5: Entry 6 · · File: USPT Nov 3, 1998

US-PAT-NO
DOCUMENT- 'S 5830548 A

TITLE: Ar : ufacture and methods for manufacturing laminate structures including n: y filled sheets

DATE-ISSU. · · 3, 1998

INVENTOR-INF TION

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; S	Santa Barbara	CA	N/A	N/A

US-CL-CUR 2 .4; 206/524.3, 206/524.7, 428/116, 428/152, 428/155, 428/182, 428/317.9 , 8/35.8, 428/36.6, 428/36.91, 428/43, 428/532, 428/906

Full Ti Review Classification Dat Reference Claims KWIC Draw Desc Image

☐ 7. · US 5830305 A

L5: Entry 7 File: USPT Nov 3, 1998

US-PAT-NO 05
DOCUMENT- 'S 5830305 A

TITLE: Me olding articles having an inorganically filled organic polymer matrix

DATE-ISSU' e 3, 1998

INVENTOR-

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen · st	Santa Barbara	CA	N/A	N/A
Hodson; S	Santa Barbara	CA	N/A	N/A

US-CL-CUR 1 /242; 264/102, 264/129, 264/132, 264/175, 264/234, 264/239, 264/299, 264/328.1 2 264/414, 264/42, 264/432, 264/45.3, 264/489, 264/490, 264/523, 264/537, 553

Full Ti Review Classification Dat Reference Claims KWIC Draw Desc Image

☐ 8. · US 5810961 A

L5: Entry File: USPT Sep 22, 1998

US-PAT-NO
DOCUMENT- : US 5810961 A

TITLE: Me manufacturing molded sheets having a high starch content

DATE-ISSU Apr 22, 1998

INVENTOR-INFORM N:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Ong; Shac	Goleta	CA	N/A	N/A
Christian e J.	Goleta	CA	N/A	N/A
Hodson; S	Santa Barbara	CA	N/A	N/A

US-CL-CURRENT: 4; 264/131, 264/132, 264/133, 264/145, 264/154, 264/160, 264/211.11, 264/282, 264/2 6-/295, 264/42, 427/393.6

Full Ti Review Classification Date Reference Claims KWIC Drawi Desc Image

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☐ 9. Docun US 5800647 A

L5: Entry of File: USPT Sep 1, 1998

US-PAT-NO
DOCUMENT- : US 5800647 A

TITLE: Me manufacturing articles from sheets having a highly inorganically filled or matrix

DATE-ISSUED: Sep 1, 1998

INVENTOR-I JOR

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; S	Santa Barbara	CA	N/A	N/A

US-CL-CURRENT: ; 156/242, 156/244.11, 156/245, 264/129, 264/138, 264/152, 264/175, 264/232,

Full Ti Review Classification Date Reference Claims KWIC Drawi Desc Image

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☐ 10. Docu D: US 5800756 A

L5: Entry File: USPT Sep 1, 1998

US-PAT-NO:
DOCUMENT- S 5800756 A

TITLE: Me ufacturing containers and other articles from hydraulically settable

DATE-ISSU 1, 1998

INVENTOR-

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; S	Santa Barbara	CA	N/A	N/A

US-CL-CUR ; 264/132, 264/234, 264/239, 264/319, 264/327, 264/333

Full Title | Review | Classification | Date | Reference | Claims | KWIC | Draw Desc | Image

☐ 11.): US 5766525 A

L5: Entry 1 -6 File: USPT Jun 16, 1998

US-PAT-NO:
DOCUMENT- 5766525 A

TITLE: Meth ufacturing articles from sheets of unhardened hydraulically settable c

DATE-ISSU 1998

INVENTOR-IN IC

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen,	Santa Barbara	CA	N/A	N/A
Hodson; Sir	Santa Barbara	CA	N/A	N/A

US-CL-CURRENT 1; 264/102, 264/129, 264/132, 264/138, 264/157, 264/175, 264/42

Full Title | Review | Classification | Date | Reference | Claims | KWIC | Draw Desc | Image

☐ 12.): US 5753308 A

L5: Entry 12 File: USPT May 19, 1998

US-PAT-NO:
DOCUMENT-ID 5753308 A

TITLE: Meth ufacturing food and beverage containers from inorganic aggregates and polys otein, or synthetic organic binders

DATE-ISSUED 998

INVENTOR-INF

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen; P	Santa Barbara	CA	N/A	N/A
Hodson; Sir	Santa Barbara	CA	N/A	N/A

US-CL-CURRENT .4; 264/112, 264/119, 264/122, 264/129, 264/133, 264/211.11, 264/294, 336, 264/42, 264/50, 264/54, 427/384, 427/393.6, 427/394, 427/397.7

Full Title | Review | Classification | Date | Reference | Claims | KWIC | Draw Desc | Image

☐ 13. : US 5738921 A

L5: Entry 1 File: USPT Apr 14, 1998

US-PAT-NO: 5 3892?
DOCUMENT-IDE : 5738921 A

TITLE: Compc : methods for manufacturing seala le, liquid-tight containers comprising :ally filled matrix

DATE-ISSUED 1998

INVENTOR-INF RMATI

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen; F	Santa Barbara	CA	N/A	N/A
Hodson; Sim	Santa Barbara	CA	N/A	N/A

US-CL-CURRE ; 206/524.3, 206/524.7, 206/819, 428/317.9, 428/34.5, 428/36.1, 428/36.5, 428/532, 428/906

Full Title Review Classification Date Reference Claims KWIC Draw Desc Image

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☐ 14. US 5736209 A

L5: Entry 1 File: USPT Apr 7, 1998

US-PAT-NO: 5 3620:
DOCUMENT-TY 5736209 A

TITLE: Compc ving a high ungelatinized starch content and sheets molded therefrom

DATE-ISSUED 1998

INVENTOR-IN

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Ong; Shaode	Goleta	CA	N/A	N/A
Christensen e	Goleta	CA	N/A	N/A
Hodson; Sim	Santa Barbara	CA	N/A	N/A

US-CL-CURR ; 428/152, 428/182, 428/317.9, 428/36.5, 428/36.92, 428/43, 428/532, 42

Full Title Review Classification Date Reference Claims KWIC Draw Desc Image

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☐ 15. US 5720913 A

L5: Entry 1 File: USPT Feb 24, 1998

US-PAT-NO:
DOCUMENT-I 720913 A

TITLE: Meth nufacturing sheets from hydraulically settable compositions

DATE-ISSU , 1998

INVENTOR-IN

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; Sim	Santa Barbara	CA	N/A	N/A

US-CL-CURR ; 264/129, 264/145, 264/152, 264/.75

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Drawn Desc | Image

16. US 5714217 A

L5: Entry [illegible] File: USPT Feb 3, 1998

US-PAT-NO:
DOCUMENT-[illegible] 5714217 A

TITLE: Seal[illegible]-tight containers comprised of coated hydraulically settable materials

DATE-ISSU[illegible], 1998

INVENTOR-[illegible]

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen,	Santa Barbara	CA	N/A	N/A
Hodson; Si[illegible]	Santa Barbara	CA	N/A	N/A

US-CL-CURR[illegible]; 206/449, 206/524.3, 206/524.6, 206/524.7, 428/310.4, 428/319.3, 428/34.7, [illegible], 428/36.6, 428/703

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Drawn Desc | Image

17. US 5709913 A

L5: Entry [illegible] File: USPT Jan 20, 1998

US-PAT-NO:
DOCUMENT-[illegible]913 A

TITLE: Meth[illegible]atus for manufacturing articles of manufacture from sheets having a highly i[illegible] filled organic polymer matrix

DATE-ISSU[illegible], 1998

INVENTOR-[illegible]

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; Si[illegible]	Santa Barbara	CA	N/A	N/A

US-CL-CURR[illegible]; 206/524.7, 229/406, 229/5.81, 229/231, 428/152, 428/168, 428/182, [illegible], 428/36.9 , 428/36.92, 428/43, 428/532, 428/906

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Drawn Desc | Image

18. US 5709827 A

L5: Entry [illegible] File: USPT Jan 20, 1998

US-PAT-NO:
DOCUMENT-I: 9827 A

TITLE: Me: ring articles having a starch-bound cellular matrix

DATE-ISSUE: 1998

INVENTOR-I:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; S:	Santa Barbara	CA	N/A	N/A

US-CL-CURR: 102, 264/129, 264/232, 264/327, 264/330, 264/53

Full | Tit | Classification | Date | Reference | Claims | KWIC | Drawi Desc | Image

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☐ 19. 707474 A

L5: Entry 1 File: USPT Jan 13, 1998

US-PAT-NO:
DOCUMENT-: 74 A

TITLE: Met: curing hinges having a highly inorganically filled matrix

DATE-ISSU: 8

INVENTOR-I:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; S:	Santa Barbara	CA	N/A	N/A

US-CL-CURR: /133, 264/151, 427/292

Full | Tit | Classification | Date | Reference | Claims | KWIC | Drawi Desc | Image

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☐ 20. 5705242 A

L5: Entry 1 File: USPT Jan 6, 1998

US-PAT-NO:
DOCUMENT-: 42 A

TITLE: Coa: containers made from inorganic aggregates and polysaccharide, protein, binders

DATE-ISSU:

INVENTOR-:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; Si:	Santa Barbara	CA	N/A	N/A

US-CL-CURR: /524.3, 206/524.6, 206/524.7, 428/317.9, 428/36.5, 428/36.6, 428/36.8,

Full | TI | Classification | Date | Reference | Claims | KWIC | Drawi Desc | Image

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☐ 21. 5705239 A

L5: Entry . File: USPT Jan 6, 1998

US-PAT-NC
DOCUMENT- 239 A

TITLE: Mc : an inorganically filled organic polymer matrix

DATE-ISSU

INVENTOR-I.

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; S	Santa Barbara	CA	N/A	N/A

US-CL-CUR 524.1, 206/524.6, 428/152, 428/162, 428/317.9, 428/339, 428/36.4, 428/532 , 428/906

Full | Ti | Classification | Date | Reference | Claims | KWI | Draw Desc | Im

☐ 22. 705238 A

L5: Entry . File: USPT Jan 6, 1998

US-PAT-NO.
DOCUMENT- 238 A

TITLE: Ar e fashioned from sheets having a highly inorganically filled organic p

DATE-ISSU

INVENTOR-I

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen;	Santa Barbara	CA	N/A	N/A
Hodson; S	Santa Barbara	CA	N/A	N/A

US-CL-CUR 20 524.3, 206/524.7, 206/819, 428/152, 428/168, 428/182, 428/35.5, 428/36.92, 428/43, 428/532, 428/906

Full | Ti | Classification | Date | Reference | Cl | KWI | Draw Desc | Im

☐ 23. 5705237 A

L5: Entry File: USPT Jan 6, 1998

US-PAT-NO
DOCUMENT- 237 A

TITLE: Hy containers and other articles for storing, dispensing, and packaging

DATE-ISSUE

INVENTOR-I

NAME	CITY	STATE	ZIP CODE	COUNTRY
And rsen;	Santa Barbara	CA	N/A	N/A
Hodson; S	Santa Barbara	CA	N/A	N/A

US-CL-CURR 20 524.3, 206/524.6, 206/524.7, 428/312.4, 428/317.9, 428/34.5, 428/34.7, 428/703

Full Title Classification Date Reference Claims KWIC Draw Desc Image

24. 'S 5705203 A

L5: Entry . File: USPT Jan 6, 1998

US-PAT-NO:
DOCUMENT-I 3 A

TITLE: Syst f mo di ticles which include a hinged st rch-bound cellular matrix

DATE-ISSUE

INVENTOR-I

NAME	CITY	STATE	ZIP CODE	COUNTRY
And rsen;	Santa Barbara	CA	N/A	N/A
Hodson; Si	Santa Barbara	CA	N/A	N/A

US-CL-CURR 4 4 ; 15, 264/327, 425/412, 425/420, 425/817R

Full Title Classification Date Reference Claims KWIC Draw Desc Image

25. 702787 A

L5: Entry File: USPT Dec 30, 1997

US-PAT-NO: 5
DOCUMENT- 02787 A

TITLE: Mold an inorganically filled oragnic polymer matrix

DATE-ISSUE 7

INVENTOR-I

NAME	CITY	STATE	ZIP CODE	COUNTRY
And rsen; e	Santa Barbara	CA	N/A	N/A
Hod on; Si	Santa Barbara	CA	N/A	N/A

US-CL-CURR 524.3, 206/524.7, 206/819, 428/220, 428/304.4, 428/317.9, 428/36.5, 4

Full Title Classification Date Reference Claims KWIC Draw Desc Image

26. 91014 A

L5: Entry File: USPT Nov 25, 1997

US-PAT-NO:
DOCUMENT-I 1614 A

TITLE: Coa ng an inorganically filled organic polymer matrix

DATE-ISSUED. 97

INVENTOR-INFORM TION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
And rsen;	Santa Barbara	CA	N/A	N/A
Hod on; S.	Santa Barbara	CA	N/A	N/A

US-CL-CURR 206/524.3, 206/524.7, 206/819, 428/ 2, 428/317.9, 428/339, 428/35.8, 4 , 428/43, 428/532

Fwd Title Classification Date Reference Claims KWIC Draw Desc Image

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27. 5683772 A

L5: Entry 27 of 46 File: USPT Nov 4, 1997

US-PAT-NO: 5683772
DOCUMENT- 3772 A

TITLE: Art ch-bound cellular matrix reinforced with uniformly dispersed fibers

DATE-ISSU 97

INVENTOR-INFORM TION:

NAM	CITY	STATE	ZIP CODE	COUNTRY
And rsen;	anta Barbara	CA	N/A	N/A
Hod on; S	anta Barbara	CA	N/A	N/A

US-CL-CURR 206/524.3, 206/524.6, 206/524.7, 42 /220, 428/310.5, 428/314.4, 428/317.9 .3 , 428/339, 428/365, 428/53

Fwd Title Classification Date Reference Claims KWIC Draw Desc Image

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28. 5679145 A

L5: Entry 2 File: USPT Oct 21, 1997

US-PAT-NO: 67
DOCUMENT- 145 A

TITLE: Sta ions having uniformly dispersed fibers used in manufacture high stre a fiber-reinforced, starch-bound cellular matrix

DATE-ISSU

INVENTOR-IN

NAM	CITY	STATE	ZIP CODE	COUNTRY
And rsen	anta Barbara	CA	N/A	N/A
Hod on; S	anta Barbara	CA	N/A	N/A

US-CL-CURR 106/162.51, 106/162.9, 106/163.01, 106/205.01, 106/206.1, 106 217. 0, 536/102

Fwd Title Classification Date Reference Claims KWIC Draw Desc Image

☐ 29. 76905 A

L5: Entry File: USPT Oct 14, 1997

US-PAT-NO
DOCUMENT- 5 A

TITLE: M ing articles of manufacture from hydraul ally settable mix ures

DATE-ISSU

INVENTOR-
NAME	ITY	STATE	ZIP CODE	COUNTRY
And rsen,	anta Barbara	CA	N/A	N/A
Hod on;	Santa Barbara	CA	N/A	N/A

US-CL-CUR 2, 264/232, 264/234, 264/239, 264/299, 264/328.1, 264/328.2 64/344, 264/42, 264/54, 264/82

Full Title Abstract Drawing Desc Image

☐ 30. 5442 A

L5: Entry File: USPT Sep 9, 1997

US-PAT-NO
DOCUMENT A

TITLE: La g a highly inorganically filled organic polymer matrix

DATE-ISSU

INVENTOR-
NAME	ITY	STATE	ZIP CODE	COUNTRY
And rsen	anta Barbara	CA	N/A	N/A
Hod on;	anta Barbara	CA	N/A	N/A

US-CL-CUR 24.1, 206/524.7, 428/144, 428/152, 428/ 65, 428/172, 428/182, 23/43, 428/53 , 428/906

Full Title Abstract Drawing Desc Image

☐ 31. 5439 A

L5: Entry File: USPT Sep 9, 1997

US-PAT-N
DOCUMENT

TITLE: A fashioned from hydraulically settable

DATE-ISS

INVENTOR

NAME	TY	STATE	ZIP CODE	COUNTRY
Anderse	nta Barbara	CA	N/A	N/A
Hodson;	nta Barbara	CA	N/A	N/A

US-CL-CU 00, 106/638, 206/449, 206/524.3, 206/5 .6, 206/524.7, 428/312. 428/703

Full Abbreviation Date Reference Claims KWIC Draw Desc Image

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32. 0904 A

L5: Entry File: USPT Aug 26, 1997

US-PAT-N
DOCUMENT

TITLE: S inorganically filled organic polymer matrix

DATE-ISS D:

INVENTOR

NAME	TY	STATE	ZIP CODE	COUNTRY
Anderse	nta Barbara	CA	N/A	N/A
Hodson;	nta Barbara	CA	N/A	N/A

US-CL-CU 4 2 24.3, 206/524.6, 206/524.7, 428/152, 428/184, 428/295.1, 428/295. 4 4/532, 428/906

Full Abbreviation Date Reference Claims KWIC Draw Desc Image

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33 US 0903 A

L5: Entry File: USPT Aug 26, 1997

US-PAT-N
DOCUMENT

TITLE: S inorganically filled organic polymer matrix

DATE-ISS

INVENTOR

NAME	TY	STATE	ZIP CODE	COUNTRY
Anderse	nta Barbara	CA	N/A	N/A
Hodson;	nta Barbara	CA	N/A	N/A

US-CL-CUR 2, 428/182, 428/317.9, 428/339, 428/9 , 532, 428/906

Full Abbreviation Date Reference Claims KWIC Draw Desc Image

☐ 34 U [illegible]0 A

L5: Entry [illegible] File: USPT Aug 26, 1997

US-PAT-NO
DOCUMENT- [illegible] 5 A

TITLE: I[illegible] [illegible]rch-bound compositions for manufacturing containers and other ar[illegible] [illegible]ynamically controlled cellular matrix

DATE-ISS[illegible] 1[illegible]

INVENTOR-

NAME	[illegible]Y	STATE	ZIP CODE	COUNTRY
Andersen	[illegible]ta Barbara	CA	N/A	N/A
Hodson;	[illegible]ta Barbara	CA	N/A	N/A

US-CL-CU[illegible] [illegible]8, 428/310.5, 428/317.9, 428/318.8, [illegible]8/36.4, 428/36.5, 521/68, [illegible] 12 [illegible]4-6, 524/449, 524/493

Full [illegible] [illegible] Date Reference [illegible] Claims KWIC Draw Desc [illegible]

☐ 35 U [illegible]48 A

L5: Entry [illegible] File: USPT Aug 5, 1997

US-PAT-NO
DOCUMENT-

TITLE: Ce[illegible] [illegible]ag[illegible] [illegible]ntainers

DATE-ISS[illegible]

INVENTOR-

NAME	[illegible]Y	STATE	ZIP CODE	COUNTRY
Andersen	[illegible]a Barbara	CA	N/A	N/A
Hodson; S	[illegible] Barbara	CA	N/A	N/A

US-CL-CU[illegible] [illegible]1.1, 206/524.6, 206/524.7, 428/312.4, [illegible]8/34.7.9, 428/34.7, 428/36.4,

Full [illegible] [illegible] Date Reference [illegible] Claims KWIC Draw Desc [illegible]

☐ 36 U [illegible]5 A

L5: Entry [illegible] File: USPT Jun 24, 1997

US-PAT-NO
DOCUMENT-

TITLE: Hi[illegible] [illegible]lous matrices and methods for their manufacture

DATE-ISSU[illegible]

INVENTOR-

NAME	[illegible]TY	STATE	ZIP CODE	COUNTRY
Andersen	[illegible] Barbara	CA	N/A	N/A
Hodson;	[illegible] Barbara	CA	N/A	N/A

US-CL-CU[illegible] [illegible]1, 106/698, 106/713, 106/805, 428/220, [illegible]8/34.7, 428/312.[illegible] [illegible]0[illegible].17

Full | T... | Action | Date | Reference | Cl... | KWIC | Dra...

☐ 37. 7 A

L5: Entry File: USPT May 20, 1997

US-PAT-NO
DOCUMENT

TITLE: L... s having a cementitious structural matrix and methods for thei...

DATE-ISS...

INVENTOR-
NAME | STATE | ZIP CODE | COUNTRY
Andersen | ...arbara | CA | N/A | N/A
Hodson; ... | ...arbara | CA | N/A | N/A

US-CL-CU... 2 , 428/312.4, 428/319.1, 428/70, 442/370, ... 2/386, 52/309.1...

Full | T... | Action | Date | Reference | Cl... | KWIC | Dra...

☐ 38 3 A

L5: Entry File: USPT May 20, 1997

US-PAT-NO
DOCUMENT-

TITLE: Hi... norganically filled matrix

DATE-ISS...

INVENTOR-
NAME | STATE | ZIP CODE | COUNTRY
Andersen | ...arbara | CA | N/A | N/A
Hodson; ... | ...arbara | CA | N/A | N/A

US-CL-CUR 521 6/277, 16/385, 206/524.7, 206/562, 428/159, 428/168, 428/182, 428 .8, 428/532

Full | T... | Action | Date | Reference | Cl... | KWIC | Dra...

☐ 39. 6631 2 A

L5: Entry File: USPT May 20, 1997

US-PAT-N(DOCUMENT- ¯52

TITLE: C(¯ ¯ ..ng containers

DATE-ISS(

INVENTOR-

NAME	..TY	STATE	ZIP CODE	..NTRY
Andersen	..nta ..rbara	CA	N/A	..A
Hodson;	..nt.. ..arbara	CA	N/A	A

US-CL-CU... ..06/524.3, 206/524.6, 206/524.7, ..., ..4, 428/317.9, 428/319.. ..36.6, 428/703

Full | Ti... Cit... ..tion | Date | Reference | Cla... KWIC | Dra... ..ge

40. ... A

L5: Entry File: USPT May 6, 1997

US-PAT-N(DOCUMENT- ¯54

TITLE: S... bl.. ..ydraulically settable materials

DATE-ISS(

INVENTOR-

NAME	..Y	STATE	ZIP CODE	..UNTRY
Andersen	..nta ..rbara	CA	N/A	..A
Hodson;	nt.. rbara	CA	N/A	A

US-CL-CU... /... 106/729, 106/730, 10../DIG.2, 428/..., ..28/182, 428/220, ...703, 428/906

Full | Ti... Wor... ..ation | Date | Reference | Cla... KWIC | Dra... ..ge

41. ... 7 A

L5: Entry File: USPT Mar 25, 1997

US-PAT-N... 7 DOCUMENT

TITLE: S... ..r bl.. ..ydraulically settable compositions

DATE-ISS(

INVENTOR-

NAME	..Y	STATE	ZIP CODE	..UNTRY
Andersen	... ..arbara	CA	N/A	..A
Hodson;	..ta ..arbara	CA	N/A	..A

US-CL-CU... /4... 106/638, 428/152, 428/..7, 428/..., /220, 428/312.. ..3 ..28/703, 428/906

Full | ... ..ication | Date | Reference | Claims | KWIC | Dra... ..ge

☐ 42 0 A

L5: Entr File: USPT Dec 10, 1996

US-PAT-N
DOCUMENT-

TITLE: M of sheets having a highly inorgani filled organic polymer

DATE-ISS

INVENTOR

NAME	ITY	STATE	ZIP CODE	OUNTRY
Anderse	arbara	CA	N/A	/A
Hodson;	arbara	CA	N/A	/A

US-CL-CU 1, 264/101, 264/108, 264/ , 264/ 4/145, 264/175, 264/294,

Full Date Reference Claims KMC Draw Image

☐ 43 9 A

L5: Entr File: USPT Dec 3, 1996

US-PAT-N
DOCUMENT

TITLE: M articles of manufacture from hydrau ly settable sheets

DATE-ISS

INVENTOR

NAME	Y	STATE	ZIP CODE	OUNTRY
Anderse	Barbara	CA	N/A	/A
Hodson;	Barbara	CA	N/A	/A

US-CL-CU 1 /2 56/ , 156/203, 156/204, 156/344 8, 15 , 156/257, 156/285, 264/211, 264/134, 264/148, 264/ 2, 26 5 4/177.11, 264/211, /295, 264/296, 264/322, 264/333, 427/292, 53/450,

Full Date Reference Claims KMC Draw Image

☐ 44 0 A

L5: Entr File: USPT Aug 13, 1996

US-PAT-N
DOCUMENT- 5454 A

TITLE: M ...ing an inorganically filled organic polymer matrix

DATE-ISS

INVENTOR
NAME		STATE	ZIP COD	COUNTRY
Anderse	Santa Barbara	CA	N/A	N/A
Hodson;	Santa Barbara	CA	N/A	N/A

US-CL-CU 4.3, 206/524.7, 206/819, 1[illegible]/152, 428/182, 428/220, 428/297. , 428/313.9, 428/317.9, 428/339, 4[illegible]/35.6, 428/35.7, 428/36.4 /532, 428/906

Full ... Classification | Date | Reference | Claim | ... | Draw Desc | Image

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☐ 45 5186 A

L5: Entr File: USPT Aug 6, 1996

US-PAT-N
DOCUMEN A

TITLE: S ...ght, thin-walled containers made from hydraulically settable material

DATE-ISS

INVENTOR
NAME		STATE	ZIP COD	COUNTRY
Anderse	Barbara	CA	N/A	N/A
Hodson;	Santa Barbara	CA	N/A	N/A

US-CL-CU ..., 106/638, 106/714, 106/[illegible], 206/[illegible]49, 206/524.3, 206/524. , 428/319.3, 428/34.5, 428/[illegible]1.7, 428/35.4, 428/36.5, 428/36.6

Full ... Classification | Date | Reference | Claim | ... | Draw Desc | Image

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☐ 4(0046 A

L5: Entr File: USPT Apr 9, 1996

US-PAT-N
DOCUMEN A

TITLE: A ...fashioned from sheets having a highly inorganically filled organic ...

DATE-ISS

INVENTOR
NAME		STATE	ZIP COD	COUNTRY
Anderse	Barbara	CA	N/A	N/A
Hodson;	Barbara	CA	N/A	N/A

US-CL-CU ...1, 229/406, 229/5.81, [illegible]/031, 428/152, 428/182, 428/220, 524/425, /35.6 , 428/35.7, 428/3[illegible]4, 428/9[illegible], 428/532, 524/4, /451, 524/498, 524/650

Full | T | ssification | Date | Reference | Ca In | MC | Dr | Desc | Image

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0 Documents, starting with Document: 46

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L4: Entry 49 of 54 File: USPT Aug 13, 1996

US-PAT-NO: 5545450
DOCUMENT-IDENTIFIER: US 5545450 A

TITLE: Molded articles having an inorganically filled organic polymer matrix

DATE-ISSUED: August 13, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Andersen; Per J.	Santa Barbara	CA	N/A	N/A
Hodson; Simon K.	Santa Barbara	CA	N/A	N/A

US-CL-CURRENT: 428/34.5; 206/524.3, 206/524.7, 206/819, 428/152, 428/182, 428/220, 428/297.4, 428/312.4, 428/312.6, 428/313.9, 428/317.9, 428/339, 428/35.6, 428/35.7, 428/36.4, 428/36.5, 428/53, 428/532, 428/906

CLAIMS:

What is claimed and desired to be secured by United States Patent is:
1. An article of manufacture comprising a matrix reinforced with fibers, the matrix comprising a substantially homogeneous mixture of aggregate and organic binder, the article being foraged by removing a substantial quantity of water by evaporation from an inorganically filled mixture including:
water;
a water-dispersible organic polymer binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof;
an inorganic aggregate having a concentration in a range from about 30% to about 98% by volume of total solids in the inorganically filled mixture; and
a fibrous material,
the fibrous material being substantially homogeneously dispersed throughout the matrix of aggregate and organic binder, wherein the matrix of aggregate and organic binder has a thickness in a range from about 0.01 mm to about 1 cm and degrades after prolonged exposure to water.
2. An article of manufacture as defined in claim 1, wherein the inorganic aggregate comprises a plurality of different aggregate materials.
3. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a concentration in a range from about 50% to about 90% by volume of total solids in the inorganically filled mixture.
4. An article of manufacture as defined in claim 1, wherein the inorganic aggregate has a concentration in a range from about 60% to about 80% by volume of total solids in the inorganically filled mixture.
5. An article of manufacture as defined in claim 1, wherein the inorganic aggregate comprises individual particles that are size optimized in order to achieve a predetermined particle packing density of the inorganic aggregate.
6. An article of manufacture as defined in claim 5, wherein the inorganic aggregate has a particle packing density in a range from about 0.65 to about 0.99.
7. An article of manufacture as defined in claim 5, wherein the inorganic aggregate has a particle packing density in a range front about 0.7 to about 0.95.
8. An article of manufacture as defined in claim 5, wherein the inorganic aggregate has a particle packing density in a range from about 0.75 to about 0.9.
9. An article of manufacture as defined in claim 1, wherein the inorganic aggregate comprises a lightweight aggregate which reduces the density and increases the insulation ability of the matrix of aggregate and organic binder.
10. An article of manufacture as defined in claim 9, wherein the lightweight aggregate is selected from the group consisting of perlite, vermiculite, hollow glass spheres, porous ceramic spheres, expanded clay, lightweight expanded geologic materials, pumice, microspheres, and mixtures thereof.
11. An article of manufacture as defined in claim 1, wherein the inorganic aggregate is selected from the group consisting of clay, gypsum, calcium carbonate, mica, silica, alumina, metals, sand, gravel, sandstone, limestone, and mixtures thereof.

12. An article of manufacture as defined in claim 1, wherein the inorganically filled mixture further includes an organic aggregate selected from the group consisting of seeds, starches, gelatins, polymers, cork, agar materials, and mixtures or derivatives thereof.
13. An article of manufacture as defined in claim 1, wherein the inorganically filled mixture further includes plastic spheres.
14. An article of manufacture as defined in claim 13, wherein the plastic spheres have a concentration in a range from about 1% to about 10% by weight of total solids in the inorganically filled mixture.
15. An article of manufacture as defined in claim 13, wherein the plastic spheres are concentrated near a surface of the article.
16. An article of manufacture as defined in claim 1, wherein the inorganically filled mixture further includes a hydraulically settable material.
17. An article of manufacture as defined in claim 16, wherein the hydraulically settable material comprises portland cement.
18. An article of manufacture as defined in claim 16, wherein the hydraulically settable material is selected from the group consisting of calcium sulfate hemihydrate calcium oxide, and mixtures thereof.
19. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 0.5% to about 60% by volume of total solids in the inorganically filled mixture.
20. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 2% to about 40% by volume of total solids in the inorganically filled mixture.
21. An article of manufacture as defined in claim 1, wherein the fibrous material has a concentration in a range from about 5% to about 20% by volume of total solids in the inorganically filled mixture.
22. An article of manufacture as defined in claim 1, wherein the fibrous material comprises organic fibers.
23. An article of manufacture as defined in claim 22, wherein the organic fibers are selected from the group consisting of hemp, cotton, bagasse, abaca, flax, southern pine, southern hardwood fibers, and mixtures thereof.
24. An article of manufacture as defined in claim 1, wherein the fibrous material comprises inorganic fibers.
25. An article of manufacture as defined in claim 24, wherein the inorganic fibers are selected from the group consisting of glass, silica, ceramic, graphite, metal fibers, and mixtures thereof.
26. An article of manufacture as defined in claim 1, wherein the fibrous material comprises a mixture of fibers having varying strengths and flexibilities in order to impart such properties of strength and flexibility to the matrix of aggregate and organic binder.
27. An article of manufacture as defined in claim 1, wherein the fibrous material increases the tensile strength of the matrix of aggregate and organic binder.
28. An article of manufacture as defined in claim 1, wherein the fibrous material increases the flexibility of the matrix of aggregate and organic binder.
29. An article of manufacture as defined in claim 1, wherein the fibrous material comprises individual fibers having an aspect ratio of at least about 10:1.
30. An article of manufacture as defined in claim 1, wherein the fibrous material comprises individual fibers having an aspect ratio of at least about 100:1.
31. An article of manufacture as defined in claim 1, wherein the fibrous material comprises individual fibers having an aspect ratio of at least about 200:1.
32. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a cellulose-based polymer.
33. An article of manufacture as defined in claim 32, wherein the cellulose-based polymer is selected from the group consisting of methylhydroxyethylcellulose, hydroxymethylethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxyethylpropylcellulose, and mixtures or derivatives thereof.
34. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a starch-based polymer.
35. An article of manufacture as defined in claim 34, wherein the starch-based polymer is selected from the group consisting of amylopectin, amylose, seagel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkylstarches, dextrines, amine starches, phosphate starches, dialdehyde starches, and mixtures or derivatives thereof.
36. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a protein-based material.
37. An article of manufacture as defined in claim 36, wherein the protein-based material is selected from the group consisting of prolamine, collagen, gelatin, glue, casein, and mixtures or derivatives thereof.
38. An article of manufacture as defined in claim 1, wherein the organic polymer binder comprises a polysaccharide selected from the group consisting of alginic acid, phycocolloids, agar, gum arabic, guar gum, locust bean gum, gum karaya, gum tragacanth, and mixtures or derivatives thereof.
39. An article of manufacture as defined in claim 1, wherein the inorganically filled mixture further includes a synthetic organic polymer.

40. An article of manufacture as defined in claim 39, wherein the synthetic organic polymer is selected from the group consisting of polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinylacrylic acids, polyvinylacrylic acid salts, polyacrylimides, polylactic acid, ethylene oxide polymers, synthetic clay, latex, and mixtures or derivatives thereof.
41. An article of manufacture as defined in claim 1, wherein the concentration of the organic polymer binder is in a range from about 1% to about 60% by volume of total solids in the matrix of aggregate and organic binder.
42. An article of manufacture as defined in claim 1, wherein the concentration of the organic polymer binder is in a range from about 2% to about 30% by volume of total solids in the matrix of aggregate and organic binder.
43. An article of manufacture as defined in claim 1, wherein the concentration of the organic polymer binder is in a range from about 5% to about 20% by volume of total solids in the matrix of aggregate and organic binder.
44. An article of manufacture as defined in claim 1, wherein the organic polymer binder and fibrous material together have a concentration in a range from about 5% to about 70% by volume of total solids in the matrix of aggregate and organic binder.
45. An article of manufacture as defined in claim 44, wherein the organic polymer binder and fibrous material together have a concentration less than about 50% by volume of total solids in the matrix of aggregate and organic binder.
46. An article of manufacture as defined in claim 44, wherein the organic polymer binder and fibrous material together have a concentration less than about 30% by volume of total solids in the matrix of aggregate and organic binder.
47. An article of manufacture as defined in claim 1, wherein the total concentration of the organic polymer binder and fibrous material is in a range from about 5% to about 30% by volume of total solids in the matrix of aggregate and organic binder.
48. An article of manufacture as defined in claim 1, wherein the inorganically filled mixture further includes a dispersant.
49. An article of manufacture as defined in claim 48, wherein the dispersant is selected from the group consisting of sulfonated naphthalene-formaldehyde condensate, sulfonated melamine-formaldehyde condensate, lignosulfonate, and polyacrylic acid.
50. An article of manufacture as defined in claim 1, wherein the matrix of aggregate and organic binder further includes a discontinuous phase comprising finely dispersed voids.
51. An article of manufacture as defined in claim 1, wherein the article has a wall thickness in a range from about 0.1 mm to about 1 cm.
52. An article of manufacture as defined in claim 1, wherein the article has a wall thickness in a range from about 0.5 mm to about 5 mm.
53. An article of manufacture as defined in claim 1, wherein the article is readily degradable into environmentally neutral components.
54. An article of manufacture as defined in claim 1, wherein the matrix of aggregate and organic binder has a tensile strength in a range from about 0.05 MPa to about 70 MPa.
55. An article of manufacture as defined in claim 1, wherein the matrix of aggregate and organic binder has a tensile strength in a range from about 5 MPa to about 40 MPa.
56. An article of manufacture as defined in claim 1, wherein the matrix of aggregate and organic binder has a density in a range from about 0.1 g/cm.sup.3 to about 2 g/cm.sup.3.
57. An article of manufacture as defined in claim 1, wherein the matrix of aggregate and organic binder has a density in a range from about 0.2 g/cm.sup.3 to about 1.5 g/cm.sup.3.
58. An article of manufacture as defined in claim 1, wherein the matrix of aggregate and organic binder has a tensile strength to density ratio in a range from about 2 MPa.multidot.cm.sup.3 /g to about 200 MPa.multidot.cm.sup.3 /g.
59. An article of manufacture as defined in claim 1, wherein the matrix of aggregate and organic binder has a tensile strength to density ratio in a range from about 3 MPa.multidot.cm.sup.3 /g to about 50 MPa.multidot.cm.sup.3 /g.
60. An article of manufacture as defined in claim 1, wherein the article comprises a sheet product.
61. An article of manufacture as defined in claim 60, wherein the article comprises a plurality of sheets.
62. An article of manufacture as defined in claim 1, wherein the article comprises a container.
63. An article of manufacture as defined in claim 62, wherein the container is in the shape of a box.
64. An article of manufacture as defined in claim 62, wherein the container is in the shape of a hingedly closable box.
65. An article of manufacture as defined in claim 62, wherein the container is a corrugated box.
66. An article of manufacture as defined in claim 62, wherein the container is in the shape of a crate.
67. An article of manufacture as defined in claim 62, wherein the container is in the shape of a tube.
68. An article of manufacture as defined in claim 62, wherein the container is in the shape of a cup.
69. An article of manufacture as defined in claim 62, wherein the container is in the

shape of a clam shell container.
70. An article of manufacture as defined in claim 62, wherein the container is in the shape of an egg carton.
71. An article of manufacture as defined in claim 62, wherein the container is in the shape of a plate.
72. An article of manufacture as defined in claim 62, wherein the container is in the shape of a breakfast platter.
73. An article of manufacture as defined in claim 62, wherein the container is in the shape of a tray.
74. An article of manufacture as defined in claim 62, wherein the container is in the shape of a bowl.
75. An article of manufacture as defined in claim 62, wherein the container is in the shape of a lid.
76. An article of manufacture as defined in claim 62, wherein the container is in the shape of an article selected from the group consisting of a storing container, dispensing container, portioning container, packaging container, and shipping container.
77. An article of manufacture as defined in claim 1, wherein the article is selected from the group consisting of a liner, partition, wrapper, and cushioning material.
78. An article of manufacture as defined in claim 1, wherein the surface of the article further includes a coating material.
79. An article of manufacture as defined in claim 78, wherein the coating material is selected from the group consisting of melamine, polyvinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyacrylate, hydroxypropylmethylcellulose, polyethylene glycol, acrylics, polyurethane, polylactic acid, starch, soy bean protein, polyethylene, synthetic polymers, waxes, elastomers, and mixtures or derivatives thereof.
80. An article of manufacture as defined in claim 78, wherein the coating material is selected from the group consisting of sodium silicate, calcium carbonate, kaolin, ceramic, and mixtures thereof.
81. An article of manufacture as defined in claim 78, wherein the coating material increases the ability of the inorganically filled matrix to resist water degradation.
82. An article of manufacture as defined in claim 1, wherein the matrix of aggregate and organic binder can elongate in a range from about 0.5% to about 8% without completely fracturing.
83. An article of manufacture as defined in claim 1, wherein the article further includes printed indicia.
84. An article of manufacture as defined in claim 1, wherein the article includes a score cut defining an area where the article can more easily bend.
85. An article of manufacture as defined in claim 1, wherein the article includes a perforation defining an area where the article can more easily bend.
86. An article of manufacture as defined in claim 1, wherein the article includes a score defining an area where the article can more easily bend.
87. An article of manufacture as defined in claim 1, wherein the article includes a hinge.
88. An article of manufacture comprising a matrix reinforced with fibers, the matrix comprising a substantially homogeneous mixture of aggregate and organic binder, the article being formed by removing a substantial quantity of water by evaporation from an inorganically filled mixture including:
water;
a water-dispersible organic polymer binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof, the organic polymer binder having a concentration in a range from about 1% to about 60% by volume of total solids in the inorganically filled mixture;
an inorganic aggregate having a concentration in a range from about 30% to about 98% by volume of total solids in the inorganically filled mixture; and
a fibrous material having a concentration in a range from about 0.5% to about 60% by volume of total solids in the inorganically filled mixture,
the fibrous material being substantially homogeneously dispersed throughout the matrix of aggregate and organic binder, wherein the matrix of aggregate and organic binder has a thickness in a range from about 0.1 mm to about 1 cm and degrades after prolonged exposure to water.
89. An article of manufacture as defined in claim 88, wherein the hydrated mixture further includes an organic aggregate material selected from the group consisting of seeds, starch granules, cork, solid gelatin material, solid agar materials, and mixtures or derivatives thereof.
90. An article of manufacture as defined in claim 88, wherein the inorganic aggregate material includes calcium carbonate.
91. An article of manufacture as defined in claim 88, wherein the inorganic aggregate material includes gypsum.
92. An article of manufacture as defined in claim 92, wherein the polysaccharide organic binder comprises starch.
93. An article of manufacture comprising a matrix reinforced with fibers, the matrix comprising a substantially homogeneous mixture of aggregate and organic binder, the article being formed by removing a substantial quantity of water by evaporation from an inorganically filled mixture including:

water;
a water-dispersible organic binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof;
a fibrous material; and
an inorganic aggregate having a concentration in a range from about 30% to about 95% by volume of total solids in the inorganically filled mixture;
said fibrous material being substantially homogeneously dispersed throughout the matrix of aggregate and organic binder, the organic components of the article having a concentration of at least about 5% by volume of total solids in the matrix of aggregate and organic binder, wherein the matrix of aggregate and organic binder degrades after prolonged exposure to water and the article has a wall thickness in a range from about 0.1 mm to about 1 cm.

94. An article of manufacture as defined in claim 93, the organic polymer binder and fibrous material together having a concentration less than about 50% by volume of total solids in the matrix of aggregate and organic binder.

95. An article of manufacture as defined in claim 93, the organic polymer binder and fibrous material together having a concentration less than about 30% by volume of total solids in the matrix of aggregate and organic binder.

96. An article of manufacture as defined in claim 93, wherein the hydrated mixture further includes an organic aggregate material comprising starch granules.

97. An article of manufacture as defined in claim 93, wherein the inorganic aggregate material includes calcium carbonate.

98. An article of manufacture as defined in claim 93, wherein the inorganic aggregate material includes gypsum.

99. An article of manufacture as defined in claim 93, wherein the polysaccharide organic binder comprises starch.

100. An article of manufacture comprising a matrix reinforced with fibers, the matrix comprising a substantially homogeneous mixture of aggregate and organic binder, the article being formed by removing a substantial quantity of water by evaporation from an inorganically filled mixture including:
water;
a water-dispersible organic polymer binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof;
an inorganic aggregate having a concentration in a range from about 30% to about 98% by volume of total solids in the inorganically filled mixture; and
a fibrous material,
the fibrous material being substantially homogeneously dispersed throughout the matrix of aggregate and organic binder, the article having a wall thickness in a range from about 0.01 mm to about 2 cm, wherein the article comprises a container in the shape of a hingedly closable box.

101. An article of manufacture as defined in claim 100, wherein the article includes a hinge comprising an area of the matrix of aggregate and organic binder having reduced thickness.

102. An article of manufacture as defined in claim 101, wherein there is an increased concentration of fibers in the area of the matrix of aggregate and organic binder having reduced thickness.

103. An article of manufacture comprising a matrix reinforced with fibers, the matrix comprising a substantially homogeneous mixture of aggregate and organic binder, the article being formed by removing a substantial quantity of water by evaporation from an inorganically filled mixture including:
water;
a water-dispersible organic polymer binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof;
an inorganic aggregate having a concentration in a range from about 30% to about 98% by volume of total solids in the inorganically filled mixture; and
a fibrous material,
the fibrous material being substantially homogeneously dispersed throughout the matrix of aggregate and organic binder, the article having a wall thickness in a range from about 0.01 mm to about 2 cm, wherein the article comprises a clam shell container.

104. An article of manufacture as defined in claim 103, wherein the clam shell container includes a hinge comprising an area of the matrix of aggregate and organic binder having reduced thickness.

105. An article of manufacture as defined in claim 104, wherein there is an increased concentration of fibers in the area of the matrix of aggregate and organic binder having reduced thickness.

106. An article of manufacture comprising a matrix reinforced with fibers, the matrix comprising a substantially homogeneous mixture of aggregate and organic binder, the article being formed by removing a substantial quantity of water by evaporation from an inorganically filled mixture including:
water;
a water-dispersible organic binder selected from the group consisting of polysaccharides, proteins, and mixtures or derivatives thereof;
a fibrous material; and
an inorganic aggregate having a concentration in a range from about 30% to about 95% by

volume of total solids in the inorganically filled mixture;
said fibrous material being substantially homogeneously dispersed throughout the matrix of aggregate and organic binder, the organic components of the article having a concentration of at least about 5% by volume of total solids in the matrix of aggregate and organic binder, the article having a wall thickness in a range from about 0.1 mm to about 5 mm .